Initial Environmental and Social Examination Report

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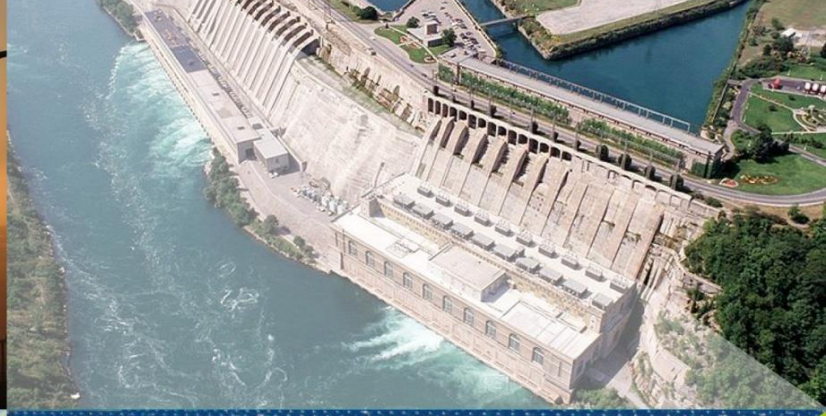
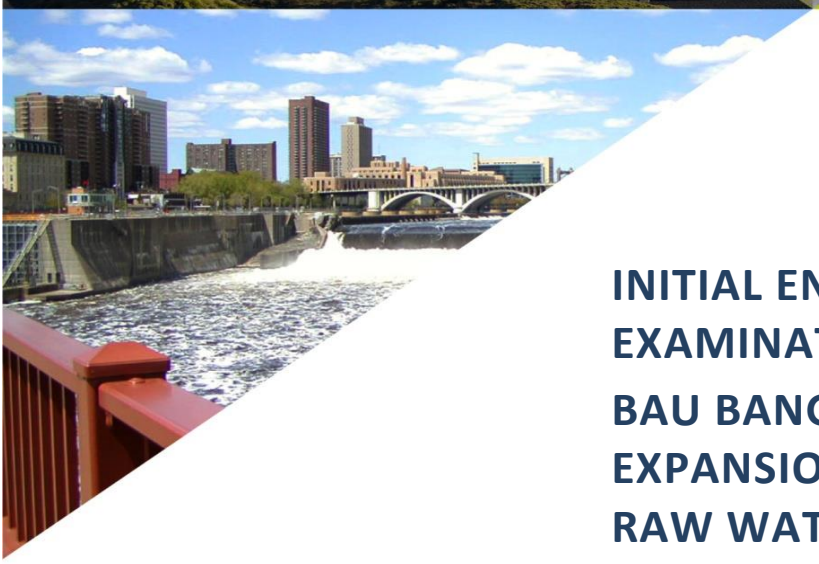
Vietnam: Thu Dau Mot Water Expansion Project

Prepared by EnviroSolutions & Consulting Pte Ltd for the Thu Dau Mot Water Joint Stock Company for the Asian Development Bank (ADB).

INITIAL ENVIRONMENTAL AND SOCIAL EXAMINATION

BAU BANG WATER TREATMENT PLANT EXPANSION AND CONSTRUCTION OF D1500 RAW WATER PIPELINE

Prepared for Thu Dau Mot Water Joint Stock Company and Asian Development Bank

Nov 2024

ESC

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AHs	Afffected Household(s)
APs	Affected Person(s)
BIWASE	Binh Duong Water Environment Joint Stock Company
BIWELCO	BIWASE Construction – Electricity Joint Stock Company
CAP	Corrective Action Plan
CBA	Collective Bargaining Agreement
CPC	Commune People's Committee
CSR	Corporate Social Responsibility
CESMP	Construction Environmental & Social Management Plan
DONRE	Department Of Natural Resources and Environment
DOC	Department of Construction
DPC	District People Committee
DPI	Department of Planning and Investment
E&S	Environmental and Social
EHSS	Environmental Health Safety and Social
EIA	Environmental Impact Assessment
EHS	Environmental, Health and Safety
EHSS	Environment and Human Health, Safety, and Security
EL	Environmental License
EPFI	Equator Principles Financial Institutions
ESCA	Environmental and Social Compliance Audit
ESMS	Environmental & Social Management System
FS	Feasibility Study
GIIP	Good International Industry Practices
HOSE	Ho Chi Minh City Stock Exchange
HR	Human Resources
HSE	Heath, Safety and Environment
IFC	International Finance Corporation
ILO	International Labour Organisation
IPO	Initial Public Offering
ISO	International Organization for Standardization
IESE	Initial Environmental & Social Examination
JICA	Japan International Cooperation Agency
JSC	Joint Stock Company

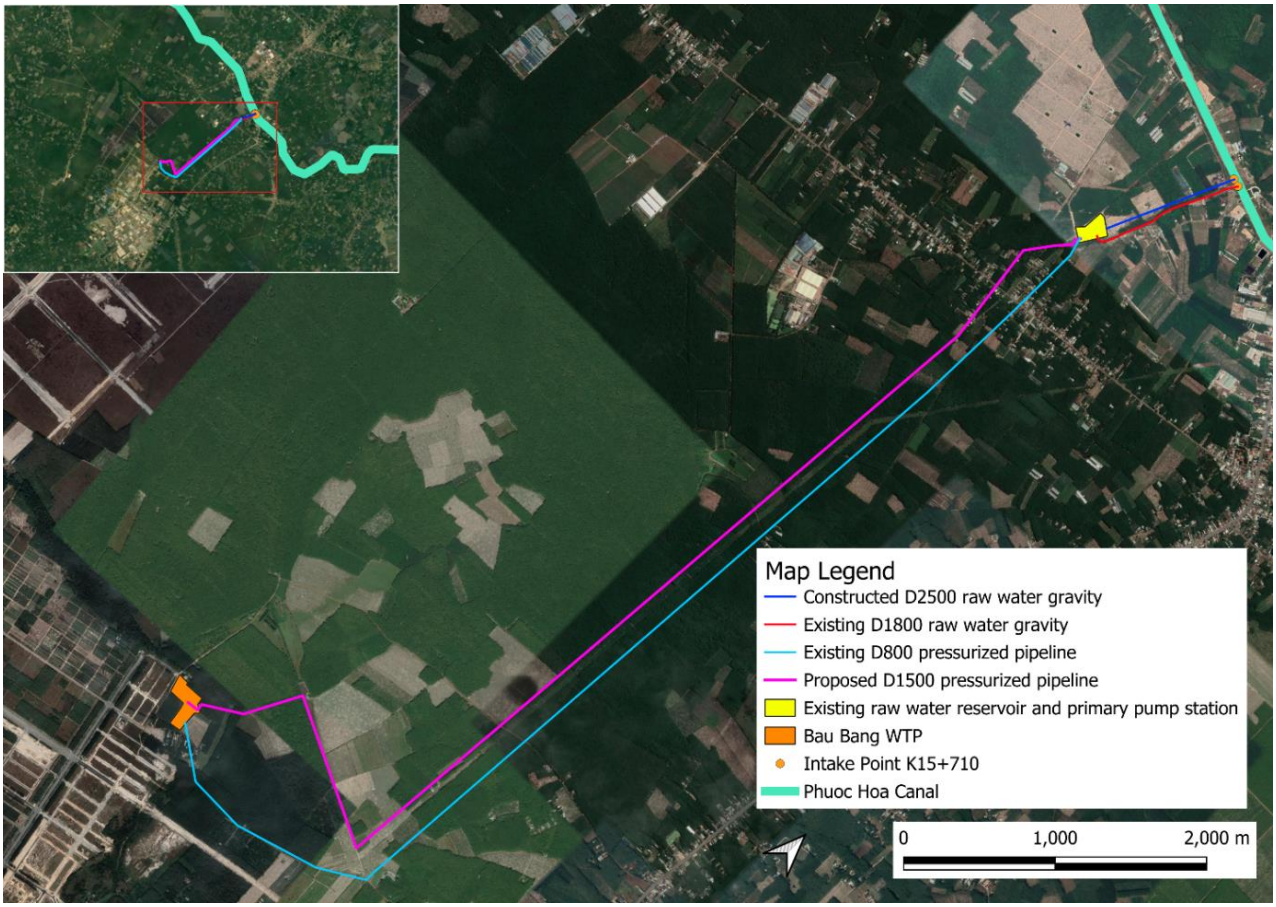
km	Kilometre
kV	Kilovolt
LEP	Law of Environment
LLC	Limited Liability Company
m3	Cubic Meter
M&E	Mechanical & Electrical
MONRE	Ministry Of Natural Resources and Environment
OHS	Occupational Health Safety
PEIA	Preliminary Environmental Impact Assessment
PIAL	Prohibited Investment Activities List
PPP	Public-Private Partnership
PS	Pump Station
SDG	Sustainable Development Goals
SOP	Standard Operating Procedure
SPS	Safeguard Policy Statement
SR	Safeguard Requirements
TDM	Thu Dau Mot Water
TDM.CO	Thu Dau Mot Water Joint Stock Company
TOR	Terms of Reference
TPC	Town People's Committee
USD	US Dollar
VND	Vietnam Dong (Vietnamese Currency)
WTP	Water Treatment Plant

1. EXECUTIVE SUMMARY

1.1 Project Background

Thu Dau Mot Water Joint Stock Company ("TDM"), a water utility company based in Binh Duong province, Vietnam, plans to expand Bau Bang water treatment plant (WTP) and facilities ("the Project"). The expansion Project include increasing the capacity of Bau Bang WTP by 100,000m^3/d and installation of a new 8.3 kilometre (km) raw water transmission pipeline. Subsequent to the final alignment determined immediately prior to the commencement of construction activities, the pipeline length was reduced from 8.3km to 8.0km. The expansion of the WTP will be in two phases with 50,000 m^3/day capacity upgrading for each phase. Phase 1 will be considered for potential corporate loans by Asian Development Bank (ADB) and the Japan International Cooperation Agency (JICA) (Lenders). EnviroSolutions & Consulting (ESC) has been engaged by ADB as the Lender's consultant to carry out the Initial Environmental and Social Examination (IESE) for the Project.

The Bau Bang WTP is situated in Cay San residential area, Lai Uyen commune-level town, Bau Bang district, Binh Duong province. The raw water pump station and transmission pipeline span across Tru Van Tho commune and Lai Uyen town, Bau Bang district. The Bau Bang WTP has a current capacity of 30,000m^3/day, but further upgrade is required given the growing water demand from industries and households. To address this increased demand, an additional D1500 pressurized raw water pipeline connecting Tru Van Tho pumping station to Bau Bang WTP is needed to allow the transmission capacity to increase from 30,000m^3/day to 350,000m^3/day (allocated for further future expansion).



1.2 Key Findings

During the preparation of the IESE, ESC conducted a thorough review of reliable sources and obtained available baseline data from the local regulatory EIA and FS. Additionally, ESC carried out two site surveys in August 2023 and May 2024 which included two initial stakeholder engagement to collect the socio-economy baseline information and consult with the local people on the potential impacts and their perception of the Project.

To complement the environmental baseline information, ESC integrated the results from supplementary environmental baseline monitoring and sampling campaigns during local EIA development process. This included the collection of five surface water quality samples, three groundwater quality samples, five air quality samples, and three soil quality samples. Additionally, continuous noise monitoring was carried out at six locations over daytime and night-time.

The laboratory analysis results indicated that the baseline water quality in the Project area is in good condition and are suitable for use in treatment for domestic water supply per applicable local standards. The ambient noise levels measured at three selected households were relatively low compared to the limits in Vietnam national standards but slightly higher than the IFC EHS guideline thresholds. The terrestrial soil quality has no signs of pollution and all measured soil quality results were well below the permissible limits prescribed in National Technical Regulation as well as WBG EHS Guidelines.

There are no protected areas or Key Biodiversity Areas (KBA) within 20km from the Bau Bang WTP project footprint, including the expansion. The aquatic baseline surveys at the intake point also indicated a low biodiversity value, with no rare or endangered species identified. However, there is concern that with the presence of *Poropuntius deauratus* (one of the EN fish triggering Vinh Cuu Extension KBA) in the catchment feeding into the Phuoc Hoa- Dau Tieng canal means this fish species might still be present along the canal and could to enter the reservoir at the pumping station. A rapid critical habitat assessment supported by catchment analysis was undertaken. There are 86 threatened flora and fauna species potentially reside within a 50km buffer zone from the project area. Nevertheless, these species are not expected in significant numbers in the project area because of the heavily altered habitat and conversion of natural landscapes to agricultural use and other continuous human activities. On a precautionary basis, the overall project area is therefore considered to be Critical Habitat only for the *Poropuntius deauratus.* A detail impact assessment and associated mitigations for aquatic life protection were addressed in this IESE.

Various socio-economic baseline and impacts to the affected communes including Tru Van Tho commune and Lai Uyen town have been identified and assessed in the IESE. Social economic data has been sourced from multiple channels encompassing desktop research, outcomes from local stakeholder engagements, interviews conducted with 25 representative households during field surveys conducted between 09-10 May 2024, as well as readily available secondary information.

The impact assessment has been undertaken using the regulations and laws as they stand at the time of the assessment, along with site observations and socio-economic surveys carried out in Aug 2023 and May 2024 that Option 2 of Segment 1 was adopted. Option 2 subsequently be changed to Option 3 at Segment 1, of which baseline and impact changes are not covered in this report due to cut of date of the project details.

Under the described methodology, all the environmental and social economic impacts from the project were assessed. The majority of the Project impacts were categorized initially as Minor or Negligible (10 identified impacts) with three potential impacts identified as Moderate. The development is deemed feasible without causing any Major impacts. Proposed mitigation measures outlined in the IESE are expected to reduce all identified impacts to either Minor or Negligible levels. Moreover, the project is expected to provide positive impacts on job creation, supplying additional portable water for increased demands, and resulting in local economic development.

All three moderate impacts, including (1) occupational, health and safety (OHS) during the construction phase, (2) chemical usage and storage in the operation phase as well as (3) impacts on aquatic life during the operation phase of the WTP are further detailed below.

- OHS: The construction involves high-risk activities with the potential for accidents that may result in injuries, fatalities and lost man-hours. The likelihood of these risks occurring is daily in every activity. In addition, there is poor enforcement of occupational health and safety regulations in Vietnam.
- Chemical usage and storage: Chlorine is listed as a hazardous and toxic chemical, which needs a specific Management Plan for Prevention, Response for Emergency Incident. However, the Project has not developed any specific management plan to handle, storage and usage of Chlorine.
- Aquatic life: During the site visit, fish were found in both the reservoir at the pumping station and the tanks of the existing Bau Bang WTP due to the lack of facilities to prevent their entry at the intake point. Given the potential for fish entrapment, including an IUCN endangered fish (Poropuntius deauratus) sighted in the upstream catchment in the Dong Nai Natural Reserved, this impact is considered permanent and may affect aquatic species in absence of mitigation measures for long term operation.

Detailed summary of the impact assessment for the key environmental and social economic aspects during the construction phase and operational phase are provided in Table 10-1 and Table 10-2 respectively.

1.3 Environmental and Social Management Plan

Following the IESE findings, an Environmental and Social Management Plan (ESMP) that delineated specific mitigation measures and monitoring strategies was developed. The ESMP aimed to guide the Project's implementation toward responsible and sustainable management by minimizing impacts to acceptable levels. Ensuring the effective alignment and implementation of the ESMP with ADB SPS and JICA Guidelines for E&S Considerations is crucial for managing environmental and social impacts to acceptable levels. Both TDM and its Construction Contractor bear responsibility for executing these plans. It is recommended to refer to the complete ESMP for guidance. Summary of the recommended mitigation measures are provided in Table 9-1.

TDM is obliged to implement the ESMP with adequate and qualified personnel working under an appropriate organizational structure in line with Project standards and including stakeholder participation and information sharing requirements to ensure that Construction contractors/subcontractors to adopt management controls. The key parties and their primary roles in implementing the ESMP:

- TDM is responsible for the overall Project monitoring and ensuring compliance with environmental policy and obligations established in the ESMP;
- Construction Contractor/Subcontractor(s) are responsible for complying with ESMP requirements set out by the TDM; and
- At project level, the Project Director / WTP Manager (for construction/operation phase) will be responsible for all appointments for environmental and social practices, approval of the Project's Environmental and Social Policy, and appointment of a suitable qualified EHSS Manager and ensure full implementation of the ESMP. In addition, the EHSS Manager will ensure all environmental monitoring requirements are being followed.

Summary of the Monitoring Plan of Key Aspect During Construction Phase and Operation Phase are provided in Table 9-2. In addition, Table 10-3 lists the recommended plans and follow-up actions for managing identified risks and align with applicable standards.

1.4 Conclusion

This IESE report of Bau Bang expansion WTP and its associated facilities has been prepared based on the previous E&S audit report, FS technical report, draft local EIA report and available studies and reports relevant to the Project, site visits, environmental and social baseline data collection and the stakeholder engagement. Overall, the Project's environmental and social impacts are considered manageable and appropriately addressed. Moreover, throughout the public consultation meetings with relevant stakeholders, there was not recorded any opinions against the project implementation. The Project is recommended to be proceeded to enhance water security in Binh Duong province for future demands of economy growth.

2. INTRODUCTION

2.1. Background and Location

The Asian Development Bank (ADB) and the Japan International Cooperation Agency (JICA) are processing potential corporate loans to Thu Dau Mot Water Joint Stock Company ("TDM", or "the Company"), a water utility company based in Binh Duong province, Viet Nam for expanding the existing Bau Bang water treatment plant (WTP), proposed 8.3 km pipeline in length (which subsequently be finalised to be 8.0km), and associated facilities (the Project)[1]. EnviroSolutions & Consulting Pte Ltd (ESC) has been engaged by ADB to undertake the Initial Environmental and Social Examination (IESE) for the said expansion of the Project (i.e. "the Subproject"), in accordance to the ADB's Safeguard Policy Statement (SPS, 2009).

TDM provides treated bulk water supply to Binh Duong Water Environment Joint Stock Company (BIWASE), Binh Duong's monopoly water distributor, for potable water supply to both households and industrial parks in Thu Dau Mot city, Binh Duong province. The Company is responsible for the management and treatment of raw water to ensure it is safe and meets quality standards. Treated water is stored in large reservoirs or tanks to ensure there is sufficient supply to meet demand and it also extracts and distributes water through a network of pipelines from the river/lake to the treatment plants and to existing BIWASE connection points.

The Bau Bang WTP has a current capacity of 30,000 m^3/day, and further upgrade is required given the growing water demand from industries and households alike, which is expected to reach around 130,000m^3/day by 2028, implemented in 2 phases: 50,000 m^3/day increase for Phase 1 by 2025, and another 50,000 m^3/day increase for Phase 2 by 2028. To address this increased demand and the upgraded WTP, an additional proposed 8.3 km pipeline in length (which subsequently be finalised to be 8.0km) pressurized raw water pipeline connecting to the Phuoc Hoa - Dau Tieng channel is needed. This pipeline expansion will allow the transmission capacity to increase from 30,000m^3 /day to 350,000 m^3/day (i.e. allow for potential future expansion beyond 2025). The main source of TDM's water supply comes from the Dong Nai River and Phuoc Hoa Dam. The pipeline will be located along Bau Long stream safety corridor, crossing under provincial and commune-level roads (around 1.35 km), along an existing 110kV transmission line (TL) corridor (approximately 5.24 km), and traverse a rubber tree farm along its drainage trench (around 1.4 km).

2.2. Objective of IESE

This IESE covers the construction and operation of the following facilities:

- The Bau Bang WTP expansion project from 30,000 m3/day to 130,000 m3/day (50,000 m3/day increase for Phase 1 funded by ADB and JICA and another 50,000 m3/day for Phase 2); and
- The 8.3 km pipeline in length (which subsequently be finalised to be 8.0km) raw water transmission pipeline of D1500 from Tru Van Tho pumping station to the Bau Bang WTP.

The objectives of the IESE study are as follows:

- To understand the existing of natural and social environments in the project area, through studying the physical environment, biological environment, and socio-economic conditions;
- To inform the project development activities to local agencies, affected people, and concerning parties to receive relevant information, key feedbacks, issues, and comments concerning environmental and social safeguards or impacts and proposed solutions or responses;

[1] The final alignment and length of 8.0km was determined immediately prior to the commencement of construction activities.

- To assess the potential impacts on the environmental-social resources in and around project site by the proposed project activities in order to provide the mitigation measures or correcting actions;
- To assess and predict the impact on environmental and social resources during construction, operation, and closure of the project;
- To extract valuable comments and experiences from ministries, related institutions, local authority, community, and stakeholders to improve the project activities with environmental sound technologies; and
- To form the basis for development of an Environmental and Social Management Plan for the construction and operational phases of the subproject, to ensure that environmental and social impacts are managed in compliance to the ADB SPS.

2.3. ADB and Domestic Environmental Due Diligence

2.3.1 IESE Requirements

This IESE has been prepared in conjunction with the preparation of the detailed engineering design thereby ensuring that engineering designs, construction methods and operations are environmentally sound and in compliance the laws, regulations and guidelines of Vietnam and with ADB Safeguard Policy Statement.

The IESE includes an Environmental and Social Management Plan (ESMP). The IESE and/or ESMP will be updated if found necessary to address any significant future changes to the Subproject and/or the context of the subproject.

The requirements for Ministry of Natural Resource and Environment (MONRE) approvals under Vietnamese law are set out in detail in section 3.1.2. An independent local consultant has been engaged by TDM to prepare the local environmental impact assessment (EIA) report for approval. It is informed that the local EIA is expected to get approval by Quarter 3 2024.

2.3.2 Structure of the IESE

This IESE report follows the format prescribed in ADB SPS 2009 and contains:

- The legal and administrative framework;
- A description of the project;
- The environmental and social baseline in the subproject locations;
- Anticipated environmental and social impacts;
- Proposed mitigation measures
- Analysis of relevant alternatives; and
- Information disclosure, consultations and participation.

The ESMP for the Subproject describes the environmental and social mitigation measures, sets out the environmental and social monitoring programmes and management for all phases of subproject implementation. The ESMP is structured in the following main sections:

- Brief subproject descriptions
- Summary of significant environmental and social adverse impacts on key receptors;
- Mitigation measures for implementation at all phases of construction and operation;
- Monitoring requirements;

- Implementation arrangements, including Institutional arrangements and responsibilities for ESMP implementation; and Estimated costs of environmental safeguard measures.

Based on the ESMP, the Contractor engaged for construction works is required to develop a detailed Construction Environmental and Social Management Plan (CESMP), which shall include specific mitigation and monitoring measures taking sensitive receptors into account as set out in the ESMP in the IESE. The Contractor shall obtain approval of the CESMP from TDM and ADB before starting construction works.

3. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

3.1 Environmental Assessment Requirements

3.1.1 Environmental Assessment Requirements of ADB

Safeguard requirements for all projects funded by ADB are defined in SPS 2009 which establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound; are designed to operate in compliance with applicable regulatory requirements; and are not likely to cause significant environmental, health, or safety hazards. SPS 2009 is underpinned by the ADB Operations Manual, Bank Policy (OM Section F1/BP, October 2013). The policy also promotes adoption of international good practice as reflected the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. This IESE is intended to meet SPS 2009 requirements.

SPS 2009 environmental assessment requirements specify that:

- At an early stage of project preparation, the borrower/client will identify potential direct, indirect, induced and cumulative environmental impacts and risks to physical, biological, socio-economic, and cultural resources and determine their significance and scope, in consultation with stakeholders, including affected people and concerned nongovernment organizations. If potentially adverse environmental impacts and risks are identified, the borrower/client will undertake an environmental assessment as early as possible in the project cycle;
- The assessment process will be based on current information, including an accurate project description, and appropriate environmental and social baseline data;
- Impacts and risks will be analysed in the context of the project's area of influence;
- Environmental impacts and risks will be analysed for all relevant stages of the project cycle, including preconstruction, construction, operations, decommissioning, and post-Closure activities such as rehabilitation or restoration; and
- The assessment will identify potential transboundary effects as well as global impacts.

Other requirements of SPS 2009 include:

- Analysis of alternatives. There is a requirement to examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and consider the no project alternative. SPS 2009 states that this is only for projects which have ''significant adverse environmental impacts that are irreversible, diverse, or unprecedented'' i.e., category A projects. This does not apply to this category B IESE but is included for completion;
- Environmental management plan. The borrower/client will prepare an EMP that addresses the potential impacts and risks identified by the environmental assessment;
- Consultation and participation. The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation;

- Information disclosure. Environmental information on the project, including the IESE and other safeguards information will be disdisclosed in accordance with ADB's Public Communications Policy (2011) and SPS (2009). This includes: (i) The EMP will be translated into Vietnamese language and be made available at Binh Duong provincial Department Natural of Resource and Environment (DONRE) ; (ii) The IESE will be disclosed on ADB's project website (www.adb.org);
- Grievance redress mechanism. The borrower/client will establish a mechanism to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the project's environmental performance;
- Monitoring. The borrower/client will monitor and measure the progress of implementation of the EMP.

As stated in the "Guidelines for Climate Proofing Investments in the Water Sector: Water Supply and Sanitation, Climate Impacts", ADB (2016) there may be impacts from climate change on water treatment. Changes in the frequency and intensity of extreme weather events, as well as and in the projected rise in sea-level and the intensification of storm surges mean changes in quantity and quality of available water resources; water infrastructure will face greater risks of damages; and services may be disrupted with greater frequency and at greater costs. These climate change risks are assessed in the project Climate Change Assessment and are reflected where appropriate in the project designs.

3.1.2 Environmental Assessments Requirements of Vietnam

In the Law on Environmental Protection 2020 (hereinafter as "LEP 2020), the environmental criteria for investment project classification are further expanded, adding areas and sensitive environmental factors such as high-density residential areas, water sources, agricultural land, types of forests, natural heritage sites, etc. In details, in LEP 2020, investment projects are classified into 4 groups:

- Group I: investment projects that pose a high risk of adverse environmental impacts
- Group II: investment projects that pose a risk of adverse environmental impacts
- Group III: investment projects that pose a low risk of adverse environmental impacts
- Group IV: investment projects that do not pose a risk of adverse environmental impacts.

The above classification is based on the following factors:

- Scale, capacity and type of business;
- Areas of land, land with water surface and marine zones in use; scale of exploitation of natural resources; and
- Sensitive environmental factors (e.g., projects in industries with high risk of causing environmental pollution and located in the urban area; projects discharging wastewater into water supply sources).

3.2 National Environmental Policy and Legislation

3.2.1 Legal Framework for Environmental Management

According to current Vietnamese regulation framework, before any plant starts official operation, the project investor will have to submit appropriate documents based on the classification of Group I, II, III and IV mentioned above (the project owner can refer to Appendices No III -No V attached in 08/2022 and Article 28 - 49 LEP 2020). This is the basis of determining which environmental dossiers must be complied, which could be summarised as:

- Preliminary Environmental Impact Assessment (PEIA): PEIA is a newly defined concept, firstly mentioned in LEP 2020. The PEIA means the consideration and identification of major environmental issues of an investment project during the pre-feasibility study or the investment

project proposal. Entities subject to PEIA include only projects of Group I, mainly targeting to large projects, public investment projects and projects pose high risks of adverse environmental impact;

- Environmental Impact Assessment (EIA): EIA report shall be made concurrently with the formulation of the feasibility study report of the investment project. The feasibility study is then also part of the dossier of request for the appraisal and approval of the EIA report including environmental baseline survey, ecological and ecosystem evaluation and biodiversity surveys, visual assessment, atmospheric dispersion and modelling studies, socio-economic analysis and environment monitoring and management plans. Group I mentioned in Clause 3 Article 28 of LEP 2020 and Group II mentioned in Points c, d, đ and e Clause 4 Article 28 of LEP 2020 are investment projects subjected to EIA report.Bau Bang expansion project is recommended from DONRE to be classified as a Group II project that will require an EIA report;
- Environmental License (EL): EL is also newly introduced and first defined in the LEP 2020. Groups I, II and III projects that generate wastewater, dusts and exhaust gases that must be treated before being emitted into the environment or generate hazardous waste that must be managed in accordance with regulations on waste management and Investment projects, dedicated areas for production, business operation and service provision and industrial clusters operating before the effective date of LEP 2020 and applying environmental criteria as the projects mentioned above are targets to submit EL for local authorities to get approval before the projects start operation;
- Environmental Registration (ER): ER obilged registrants are waste-generating investment projects not required to obtain an Environmental License and waste-generating businesses operating before the effective date of LEP 2020 not required to obtain an Environmental License;
- Exempt from Environmental Registration: Investment projects classified as state secrets in the field of national defence and investment projects in operation phase do not generate wastes or generate domestic solid waste less than 300 kg/day which is managed by the local authorities or generate less than 05 m3/day wastewater and 50 m3/day gases emission, which are treated onsite or managed by the local authorities are exempt from Environmental Registration. The exempted from Environmental Registration projects can be referenced Appendix XVI of Decree No.08/2022/ND-CP.

The Table 3-1 below illustrates a summary of the environmental dossiers must be complied for each level of investment project:

Table 3-1: Environmental dossier requirements from LEP 2020

Law/regulation	Project Category	Environmental dossiers required	Project phase
LEP 2020 (from article 28 to article 49)	Group I and part of Group II (clause 3, article 28 on project category)	PEIA EIA	Design and construction
		EL	Operation
	Part of Group II	EIA	Design and construction
		EL	Operation
	Part of Group III and IV	EL	Design, construction and operation

	Part of Group III and IV (clause 1, article 49)	ER	Design, construction and operation

3.2.2 Policies and Legal Instruments

The Vietnamese regulation framework relevant to natural water exploitation, domestic water treatment and distribution could be considered to be applied as:

Table 3-2: Relevant Laws, Regulations and Guidelines

Law/Regulation/Guideline	Year
Law on Environmental Protection (No. 72/2020/QH14)	2020
Law on Water Resources (No. 17/2012/QH13)	2012
Law on Biodiversity (No. 20/2008/QH12)	2008
Labour Code (Code No. 45/2019/QH14)	2019
Law on Social Insurance (Law No. 58/2014/QH13),	2014
Land Law 2013 and subsidiary legislation	2013
Law on Grievance 2011 and subsidiary legislation	2011
Law on Cultural Heritage 2001, the Amendment 2009 and subsidiary legislation	2001
Law on Trade Unions (No. 12/2012/QH13)	2012
Law on Employment (No. 38/2013/QH13)	2013
Law on Enterprises (No. 59/2020/QH14)	2020
Law on Occupational Safety and Health (No. 84/2015/QH13)	2015
Law on Chemical 06/2007/QH12	2007
Decree No. 02/2023/ND-CP dated 01 February 2023 of the Government elaborating certain articles of the Law on Water Resources about requirements for water resources extraction permit	2023
Decree No. 201/2013/ND-CP dated 27 November 2013 of the Government detailing the implementation of some articles of the Law on Water Resources	2016
Decree No. 09/VBHN-BTNMT dated on 25 October 2019 on Discarded material and waste management;	2019
Decree No. 201/2013/ND-CP dated 27 November 2013 of the Government detailing the implementation of some articles of the Law on Water Resources	2013

Law/Regulation/Guideline	Year
Decree No. 80/2014/ND-CP dated 06 August 2014 of the Government on the Drainage and Treatment of Wastewater	2014
Decree No. 38/2015/ND-CP dated 24 April 2015 of the Government on Management of Waste and Discarded Materials	2015
Decree No. 16/2016/ND-CP dated 16 March 2016 on management and use of Official Development Assistance (ODA) and concessional loans granted by foreign donors.	2016
Decree 132/2018/ND-CP dated 1 October 2018 of the Government amending and supplementing some articles of Decree 16/2016/ND-CP dated 16 March 2016 about management and using ODA and preferential loans of sponsors from abroad.	2018
Decree No. 43/2014/ND-CP dated 15 May 2014 on detailing a number of articles of the Land Law 2013.	2014
Decree No. 44/2014/ND-CP dated 15 May 2014 on regulations on land prices.	2014
Decree No. 47/2014/ND-CP dated 15 May 2014 on compensation, assistance, and resettlement upon land recovery by the State.	2014
Decree No. 06/2020/ND-CP dated 3 January 2020 on amendments to Article 17 of Decree No. 47/2014/ND-CP dated 15 May 2014 on compensation, support, and resettlement when the State recovers land.	2020
Decree No. 01/2017/ND-CP dated 6 January 2017 adjusting some articles of the Decree No. 43/2014/ND-CP dated 15 May 2014 on the implementation of certain articles of the Land Law, Decree No. 44/2014/ND-CP dated 15 May 2014 on land price,	2017
Decree No. 47/2014/ND-CP dated 15 May 2014 on compensation, support, and resettlement for the government's expropriation of land	2014
Decree No. 79/2014/ND-CP dated 31 July 2014 detailing some articles of Law on fire prevention and firefighting.	2014
Decree No. 39/2016/ND-CP dated 15 May 2016 providing detailed requirements of some articles of Occupational Health and Safety Law.	2016
Decree 14/2014/ND-CP dated 26 February 2014 stipulating in detail the implementation of electricity law regarding electricity safety	2014
Circular No. 24/2016/TT-BTNMT dated 09 September 2016 on determination and announcement of domestic water safeguard zones	2016
Circular 27/2014/TT-BTNMT dated 30 May 2014 regulating the registration for groundwater extraction, form of dossier for issue, extension, modification, re-issue of water resource permit.	2014

Law/Regulation/Guideline	Year
Circular No. 41/2018/TT-BYT dated 14 December 2018 on promulgating national technical regulation and regulations on inspection and monitoring of domestic water quality	2018
Circular No. 36/2015/TT-BTNMT dated 30 June 2015 on management of hazardous waste	2015
Circular No. 02/2022/TT-BTNMT dated 10 January 2022 on detailing a number of article of Law of Environmental Protection	2022
Circular No. 23/2018/TT-BCT dated 28 August 2018 on Management of Environmental Protection obligation in the industry and trade sector.	2018
Decision No. 09/2020/ QD-TTg dated 18 March 2020 promulgating of regulation on waste-related Emergency Response	2020
Circular No. 36/2015/TT-BTNMT dated 30 July 2015 of MoNRE on Management of Hazardous Waste	2015
Circular No. 08/2017/TT-BXD dated 16 May 2017 on Management of Construction Waste	2017
Circular No. 36/2015/TT-BTNMT dated 30 June 2015 on management of hazardous waste	2015
Circular 02/2022/TT-BTNMT dated 10 January 2022 Detailing A Number Of Articles Of Law On Environmental Protection	2022
Circular 25/2019/TT-BTNMT dated 31 December 2019 Elaborating Some Articles Of The Government's Decree No. 40/2019/ND-CP Dated May 13, 2019 On Amendments To Decrees On Guidelines For The Law On Environmental Protection And Providing For Management Of Environmental Monitoring Services	2019
Circular 01/2023/TT-BTNMT dated 13 March 2023 on issuance of National Technical Regulations on Ambient Environment Quality	2023
Circular 02/2022/TT-BTNMT dated 10 January 2022 Detailing A Number Of Articles Of Law On Environmental Protection	2022
Circular 25/2019/TT-BTNMT dated 31 December 2019 Elaborating Some Articles Of The Government's Decree No. 40/2019/ND-CP Dated May 13, 2019 On Amendments To Decrees On Guidelines For The Law On Environmental Protection And Providing For Management Of Environmental Monitoring Services	2019
Circular No. 36/2014/TT-BTNMT dated 30 June 2014 on land pricing method.	2014
Circular No. 37/2014/TT-BTNMT dated 30 June 2014 on guidelines in the implementation of Decree No. 47/2014/ND-CP	2014
Decision No. 51/2014/QD-UBND dated 18 December 2014 on promulgating compensation, assistance, and resettlement policy when land is acquired by the State in Binh Duong province.	2014
Decision No. 38/2019/QD-UBND dated 20 December 2019 stipulating the unit price of compensation and property support when the State recovers land in the province.	2019

Law/Regulation/Guideline	Year
Decision No. 04/2017/QD-UBND dated 17 February 2017 on adjusting the price unit for types of land in the territory of Binh Duong province.	2017
Decision No. 25/QD-UBND dated 22 July 2015 on promulgating price units for compensation and assistance for affected assets on land in the territory of Binh Duong Province.	2015
Decision No. 03/2018/QD-UBND dated 9 February 2018 on amending and supplementary some articles of Decision No. 25/2015 dated 22 July 2015 on promulgating price units for compensation and assistance for affected assets on land in the territory of Binh Duong province.	2018
Decision No. 09/2023/QD-UBND dated 13 April 2023 on regulating the unit price of compensation and assistance for affected assets when land is acquired by the State in Binh Duong province. This Decision takes effect from 1 May 2023 and replaces Decision No. 38/2019/QD-UBND dated 20 December 2019.	2023
Circular No. 66/2014/TT-BCA, dated 16 December 2014 detailing some articles of Decree No. 79/2014/ND-CP.	2014
Circular No. 07/2016/TT-BLDTBXH dated 15 May 2016 detailing regulations on organisation and implementation of occupational health and safety in producing and trading facilities.	2016
Circular 48/2020/TT-BCT to promulgate of national technical regulations on safety in production, commerce, use, storage, and transportation of hazardous chemicals including Chlorine	2020
QCVN 01-1:2018/BYT - National Technical Regulation on water quality for domestic use	2018
TCXD 233:1999/BXD – National Standard for Parameters using for selection of the surface and groundwater resource in the water supply system.	1999
QCXDVN 01:2008/BXD – National Building Code for Regional and Urban Planning and Rural Residential Planning - Calculation of the water demand for Report preparation residential areas	2008
QCVN 01:2021/BXD – National Technical Regulation on Construction Planning – Water supply requirements on water pressure	2021
TCXD 33:2006/BXD – National Standard for Water Supply – Distribution System and Facilities Design	2006
QCVN 07:2009/BTNMT – National Technical Regulation on Hazardous Waste Threshold	2009
TCVN 6705:2009 – National Standard on Normal Solid Waste – Classification	2009
TCVN 6707:2009 – Hazardous Waste – Warning Signs.	2009
QCVN 07:2009/BTNMT – National Technical Regulation on Hazardous Waste Threshold	2009
TCVN 6705:2009 – National Standard on Normal Solid Waste – Classification	2009
QCVN 26:2010/BTNMT – National Technical Regulation on Noise	2010

Law/Regulation/Guideline	Year
QCVN 27:2010/BTNMT – National Technical Regulation on Vibration	2010
QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality	2023
QCVN 08:2023/BTNMT – National Technical Regulation on Surface Water Quality	2023
QCVN 09:2015/BTNMT – National Technical Regulation on Groundwater Quality	2015
QCVN 03:2023/BTNMT – National Technical Regulation on the Soil Quality	2023
QCVN 50:2013/BTNMT – National Technical Regulation on Hazardous Threshold for Sludges from Water Treatment Process	2013
QCVN 26:2010/BTNMT – National Technical Regulation on Noise	2010
QCVN 27:2010/BTNMT – National Technical Regulation on Vibration	2010
QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality	2023
QCVN 26: 2016/BYT- National Technical Regulations on Microclimate - Permissible Values for Microclimate in The Workplace.	2016
QCVN 03: 2019/BYT- National Technical Regulation on Permissible Exposure Limit Value Of 50 Chemical Elements in The Workplace.	2019
QCVN 22: 2016/BYT - National Technical Regulation on Lighting - Permissible Level of Lighting in The Workplace.	2016
QCVN 24:2016/BYT – National Technical Regulation on Noise - Permissible Exposure Levels of Noise in The Workplace	2016
QCVN 27:2016/BYT - National Technical Regulation on Vibration - Permissible Exposure Levels of Vibration in The Workplace.	2016
QCVN 02: 2019/BYT- National Technical Regulation on Permissible Exposure Limit Value Of 05 Dusts at the Workplace	2019
QCVN 26: 2016/BYT- National Technical Regulations on Microclimate - Permissible Values for Microclimate in The Workplace.	2016

Table 3-3: Key National and International Environmental Standards

Environmental Issue	National Standard	International Standard
Ambient air quality	QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality	WHO Air Quality Guidelines, global update 2005

Environmental Issue	National Standard	International Standard
Noise	QCVN 26:2010/BTNMT – National Technical Regulation on Noise	WHO Guidelines for Community Noise, 1999
Groundwater quality	QCVN 09:2015/BTNMT – National Technical Regulation on Groundwater Quality	WHO Guidelines for Drinking-water Quality, Fourth Edition, 2011
Surface water quality	QCVN 08:2023/BTNMT – National Technical Regulation on Surface Water Quality	US EPA National Recommended Water Quality Criteria Mekong River Commission (MRC)_ Technical Guidelines for the Protection of Aquatic Life MRC Technical Guidelines for the Protection of Human Health
Effluent quality	QCVN 14/2011/BTNMT - National Technical Regulation on Domestic Wastewater QCVN 50:2013/BTNMT – National Technical Regulation on Hazardous Threshold for Sludges from Water Treatment Process TCVN 6705:2009 – National Standard on Normal Solid Waste – Classification QCVN 07:2009/BTNMT – National Technical Regulation on Hazardous Waste Threshold	IFC EHS General Guidelines, April 2007 IFC EHS Guidelines for Water and Sanitation, December 2007 IFC EHS Guidelines for Waste Management Facilities, December 2007 USEPA Effluent Limitations
Soil quality	QCVN 03-2023/BTNMT – National Technical Regulation on the Soil Quality	
Vibration	QCVN 27:2010/BTNMT – National Technical Regulation on Vibration	
Workplace	QCVN 26: 2016/BYT- National Technical Regulations on Microclimate - Permissible Values for Microclimate in The Workplace QCVN 03: 2019/BYT- National Technical Regulation on Permissible Exposure Limit Value Of 50 Chemical Elements in The Workplace QCVN 22: 2016/BYT - National Technical Regulation on Lighting - Permissible Level of Lighting in The Workplace QCVN 24:2016/BYT – National Technical Regulation on Noise - Permissible Exposure Levels of Noise in The Workplace	

4. DESCRIPTION OF THE PROJECT

4.1 Rationale

With the urbanization rate of Binh Duong province, water demand for both domestic and industrial development purposes is growing rapidly. According to the "Development plan of water supply system in Binh Duong in the period of 2020-2030, with a vision to 2050" submitted to the Provincial People's Committee for approval, the water demand of Binh Duong province in the future is estimated as follows:

- By 2025, it will be 830,000 m3 /day;
- By 2030, it will be 1,210,000 m3 /day;
- By 2040, it will be 1,810,000 m3 /day;
- By 2050, it will be 2,140,000 m3 /day.

According to approved "Binh Duong province's planning for the 2021-2030 period, with a vision to 2050" (Document No.790/QĐ-TT dated 03 August 2024), Bau Bang WTP will has a capacity of 350,000 m^3/day by 2050. Therefore, an expansion plan from TDM is necessary to cope with the growing water demand gradually until reaching 350,000 m^3/day by 2050 for water supply to Bau Bang district. Currently, TDM plans to expand Bau Bang WTP from the capacity of 30,000 m^3/day to 130,000 m^3/day, which will be in two phases: Increase by 50,000 m^3/day in Phase 1 and another 50,000 m^3/day increase in Phase 2. Only Phase 1 expansion will be funded by ADB and JICA. Upgrading plan is discussed in Table 4-1 for Bau Bang WTP.

Table 4-1: TDM Expansion Plan for the Bau Bang WTP to 2030

Facility	Capacity already under operation (as of end of 2023)	Capacity of expansion	Combined Capacity after expansion	Expected time of expansion
Bau Bang existing WTP				
Raw water transmission pipeline from Tru Van Tho pump station to Bau Bang WTP	D800	D1500	D800, D1500	2025
Water Treatment Plant	30,000 m^3/day	50,000 m^3/day	80,000 m^3/day	2025
		50,000 m^3/day	130,000 m^3/day	2028

4.2 Project Activities and Outputs

The activities and outputs of the Project to be loaned by ADB and JICA are as follows:

- Contributing to adequate supply of treated water to solve the shortage of treated water for production, daily life and service needs in Bau Bang district and other areas of Binh Duong province such as Ben Cat, Thu Dau Mot, Thuan An and Tan Uyen;
- Increasing the capacity of Bau Bang WTP by 80,000 m3/day (Phase 1);
- Increasing the raw water conveying capacity from 60,000 m3/day to 350,000 m3/day in accordance with the plan to develop the capacity of Bau Bang WTP;
- Construction of the D1500mm pressure raw water pipeline, which is about 8.0km long from the primary pumping station to the treatment plant to meet the needs of treated water production and

supply of raw water (untreated water) as well as to ensure the compliance with regulations on safe water supply and technical regulations on water supply works;

- Contributing to promoting socio-economic development and attracting investment in the area; and
- Contributing to increase the economic-financial investment efficiency for project owners for future expansion and reinvestment.

4.3 Project Location and Service Coverage

4.3.1 Existing Bau Bang WTP and Associated Facilities

The Bau Bang WTP is situated in Cay San hamlet, Lai Uyen town, Bau Bang district, Binh Duong province, Vietnam. The raw water pumping station and transmission pipeline span across two different communes: Tru Van Tho commune and Lai Uyen commune, both within the Bau Bang district (see Figure 4-1). The nearest sensitive receptors from pumping station are estimated approximately 300-500 meters from Tru Van Tho pumping station and Bau Bang WTP. These receptors were defined as residential households. A summary of all the existing main associated facilities is provided in Table 4-2.

Table 4-2: Summary of Bau Bang WTP and existing associated facilities[2]

No	Facilities	Description
1	Tru Van Tho raw water pump station and reservoir	Total area of 15.3 ha Including: • A 516 m^2 concrete facility equipped with 3 x 500 m^3/h and 2 x 1000 m^3/h , H = 45 m pumps (1 pump working as back up pump). The existing pump capacity can meet the demand up to 60,000 m^3/day. • Pump engines are installed variable frequency drives for each pump to operate the pumps at maximum efficiency. • Transformer station, backup power generators and other auxiliary. • Intermediate reservoir with the volume of 60,000 m^3 (1.1 ha area) to store raw water.
2	Raw water transmission pipeline	Total of approximately 9.3 km length transmission pipeline from Phuoc Hoa – Dau Tieng canal to the Bau Bang WTP: • 980m length gravity-flow pipeline (D=1800mm) from intake point at Phuoc Hoa canal (K15+710) to the main raw water reservoir. Another pipeline (D = 2500mm, L =950m) constructed parallelly with the D1800 but not yet in operation. It is understood that this D2500 pipeline is served for future expansion of the Bau Bang WTP. • 8.3km length pressurized-flow pipeline (D=800mm) made from cast iron, convey raw water from the raw water pumping station to the treatment plant.
3	Bau Bang Water treatment plant	The WTP has total area of 17.4 ha. Main auxiliaries within the WTP including: • Raw water storage reservoir (6,000 m^3) • Raw water pump station (3 x 625 m^3/h, H=15m) • Mixing tank • Rapid Filtration Tank • Clean Water Pump Station • Clean Water Storage Tank • Scanda Control Room and Chlorine Room

[2] Feasibility study for the Bau Bang Water Supply System with an upgraded capacity of 350,000 m^3/day (TDM, 2023)

No	Facilities	Description
		• Transformer Station and Power Generator • Chemical Warehouse • Sludge Drying Field. The details of the facilities such as capacity and volume etc. are provided in Appendix A.

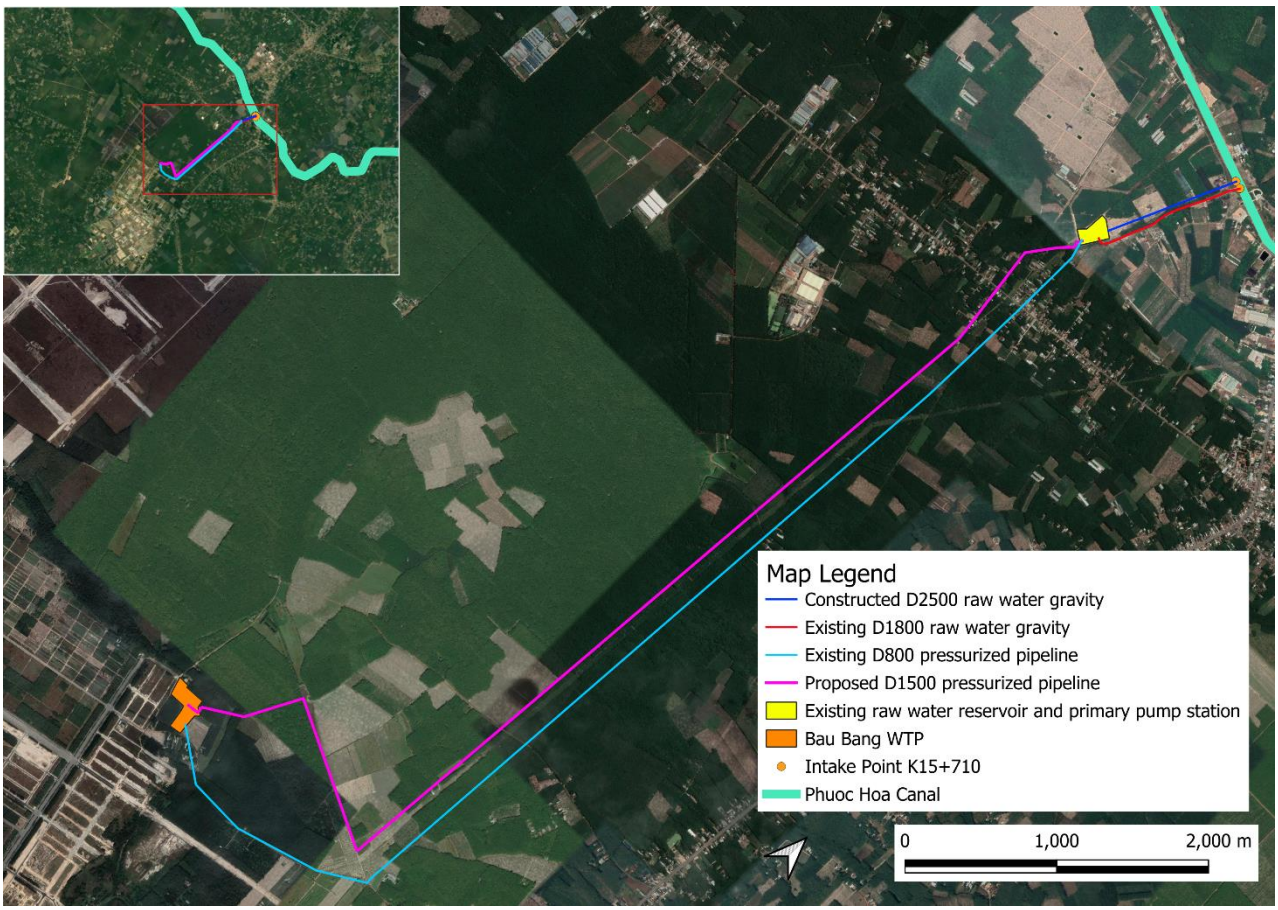


Figure 4-1: Locations of Bau Bang WTP, the proposed D1500 pipeline and associated facilities

Water intake at Phuoc Hoa Canal

The raw water supply for the Bau Bang WTP is sourced from the Dau Tieng – Phuoc Hoa Canal, which the Song Be River (the main tributary of Dong Nai River) flows into. This water source is diverted from Song Be River at Phuoc Hoa dam, flowing from North-East to South-West and flows into Dau Tieng reservoir (Tay Ninh province). Water from Phuoc Hoa – Dau Tieng canal enters a concrete intake gate situated at K15+710 along the canal (see Figure 4-2) and overflows into pipelines by gravity to a retention basin located within the pumping compound. As water level at the canal varies, retention basin was constructed to store water before being pumped to the Bau Bang WTP. At the time of site visit in August 2023, the intake pipelines include:

- A 1km in length of diameter D1800mm pipeline to overflow water from intake gate to the retention basin. This pipeline is currently under operation; and
- A D2500mm pipeline constructed parallelly with the D1800 but not yet in operation. It is understood that this pipeline is for future expansion of the Bau Bang WTP.

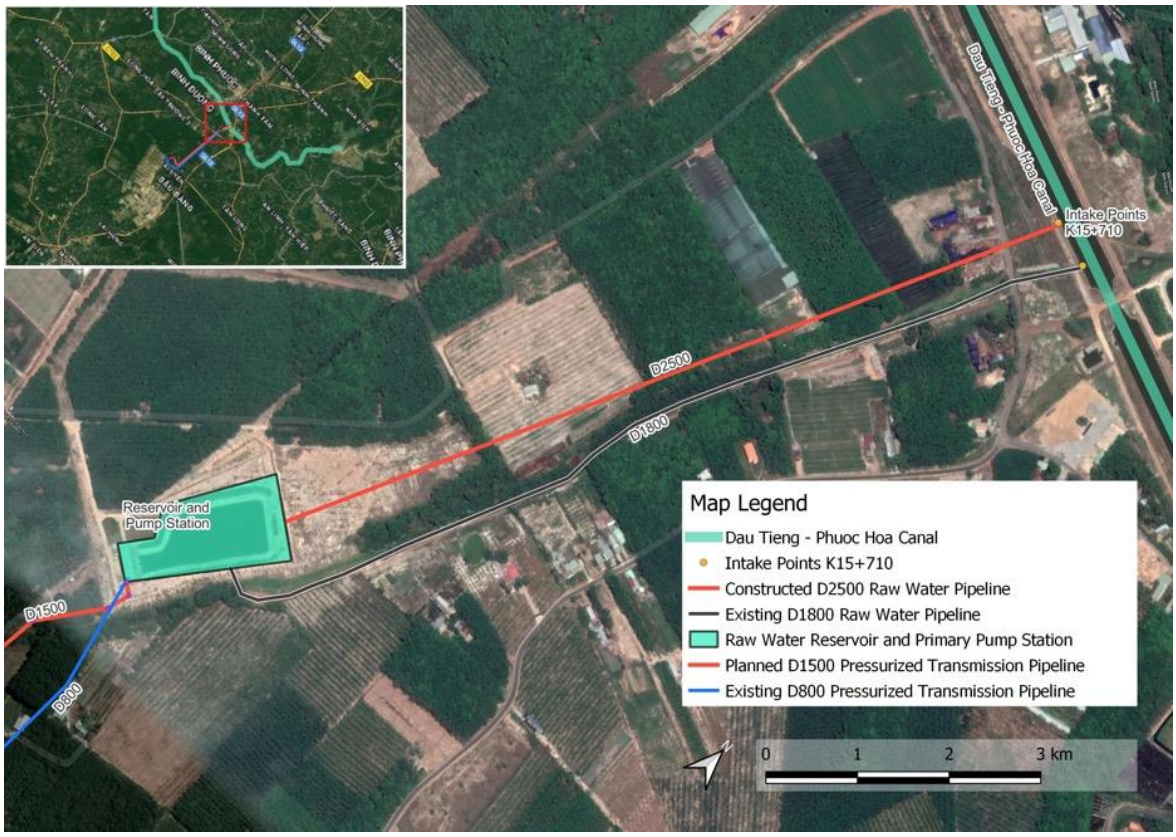


Figure 4-2: Locations of Intake Point, pipelines and pumping station

Raw Water Pumping Station

The raw water pumping station, also called the primary pumping station, has total area of 15.3 ha. This facility includes the following:

- A 516 m2 concrete house equipped with 3x 500 m3/h and 2x1000 m3/h, H = 45 m capacity pumps. The existing pump capacity can meet the demand up to 60,000 m3/day. Raw water from the intake is managed by gravity flow. No more intake point is needed to meet the 350,000 m3/day demand. The only upgrade for intake point is needed when the Project will meet the anticipated water demand till 2030;
- Pump engines are installed variable frequency drives for optimum operation efficiency;
- Intermediate reservoir with 60,000 m3 volume (1.1 ha area) to store raw water; and
- Transformer station, backup power generators and other auxiliary.

For coming Bau Bang expansion project to capacity of 130,000 m^3/day, existing water reservoir capacity at the pumping station is sufficient, as water will be remained at the same level by controlling water intake flow and water pump flow. Existing pumping station has also allocated area for additional pumps to be installed if required in the future (beyond 2025), so no extension of pumping station required.

Transmission Pipelines

There is a total of 9.35 km of existing transmission pipeline from Phuoc Hoa canal to the Bau Bang WTP, including:

- Conveying raw water from the intake point at Phuoc Hoa canal (K15+710) to the intermediate raw water reservoir at the pumping station. This transmission pipeline is self-flowing by gravity with 1km length and diameter D=1800mm. According to the Feasibility Study report (2023), this existing raw water transmission pipeline has a flow capacity of 200,000 m^3/day. To meet the future demand, a second self-flowing transmission pipeline (D=2500m) parallel with the existing was constructed but not operational at the time of this report preparation, which will allow flow capacity of 800,000 m^3/day for future expansion of the Bau Bang WTP.
- Conveying raw water from the raw water pumping station to the treatment plant, with 8.3 km length pressurized flow cast iron pipeline (D=800mm).

Bau Bang existing WTP

Currently, Bau Bang WTP has a designed capacity for Phase 1 and Phase 2 of 30,000 m^3/day. The loss rate non-treated water is 4% and this number has also been included in the stated capacity (FS, TDM 2023), resulting in an operation capacity of 30,000 m^3/day for the existing Bau Bang WTP. Auxiliaries within the WTP include a group of mixing tanks, flocculation and sedimentation tanks, settling tanks, rapid filtration tanks, storage tanks, sludge drying beds and a secondary pumping station that pumps treated water into the distribution network. Summary of design treatment capacity and the number of facilities/units is provided in Appendix A.

4.3.2 Bau Bang WTP Expansion Facilities

Raw Water Pumping Station

To supply for the demand of WTP with the extra capacity of 50,000 m^3/day, additional pumps will be installed at the dedicated area allocated for expansion in the the Tru Van Tho pumping station:

- 1 working pump (H = 45m, Q = 2,000 m^3/hour)
- 1 back up pump (H = 45m, Q = 2,000 m^3/hour)

After installation of additional pumps, the total capacity of Tru Van Tho pumping station will be nearly 120,000 m^3/day, which will satisfy the treatment capacity of Bau Bang WTP expansion at 80,000 m^3/day. Beside additional pumps, the existing 630 KVA will also be replaced with a new 1,600 KVA transformer to meet the increasing power demand.

Transmission Pipelines

In order to cope with the coming Bau Bang expansion capacity from 30,000 m^3/day to 130,000 m^3/day and the future expansion up to 350,000 m^3/day in 2050, the Project will construct a second pressurized transmission pipeline (mostly parallel with the existing one) with a diameter of 1500 mm, approximately 8.3 km in length (which subsequently be finalised to be 8.0km). The final alignment was finalised after TDM engaging the EPC contractor (BIWELCO) in July 2024. This proposed D1500 pipeline will also be loaned by ADB and JICA together with the Bau Bang WTP Expansion Project.

The final alignment pipeline connecting Tru Van Tho pumping station to Bau Bang WTP is under preparation to be constructed in 2024. This pipeline alignment will span along 8.0 km including five segments:

- Segment 1 and Segment 2: Tru Van Tho commune segment with the length of approximately 1.35 km. Starting point is at Tru Van Tho pump station and traverse along Bau Long stream safety corridor (about 560m length), then spand along TVT.39 road, crossing DT750 provincial road, traverse along TVT.40 road (about 789m length) before traveling below the existing 110kV transmission line to the boundary line of Tru Van Tho commune and Lai Uyen town.
- Segment 3 and Segment 4: This segment in Lai Uyen town will span under the 110kV TL (785m) and the 110kV and 220kV TLs (4,457m) for about 5.24 km before having a perpendicular turn to Segment 3. This segment is designed to be parallel with the existing D800 pipeline; and
- Segment 5: The final segment with 1.4km length will cross an area mostly covered by rubber trees then connect to Bau Bang WTP. Part of the pipeline is within the rubber tree areas built Bau Bang WTP compound that is belong to TDM.

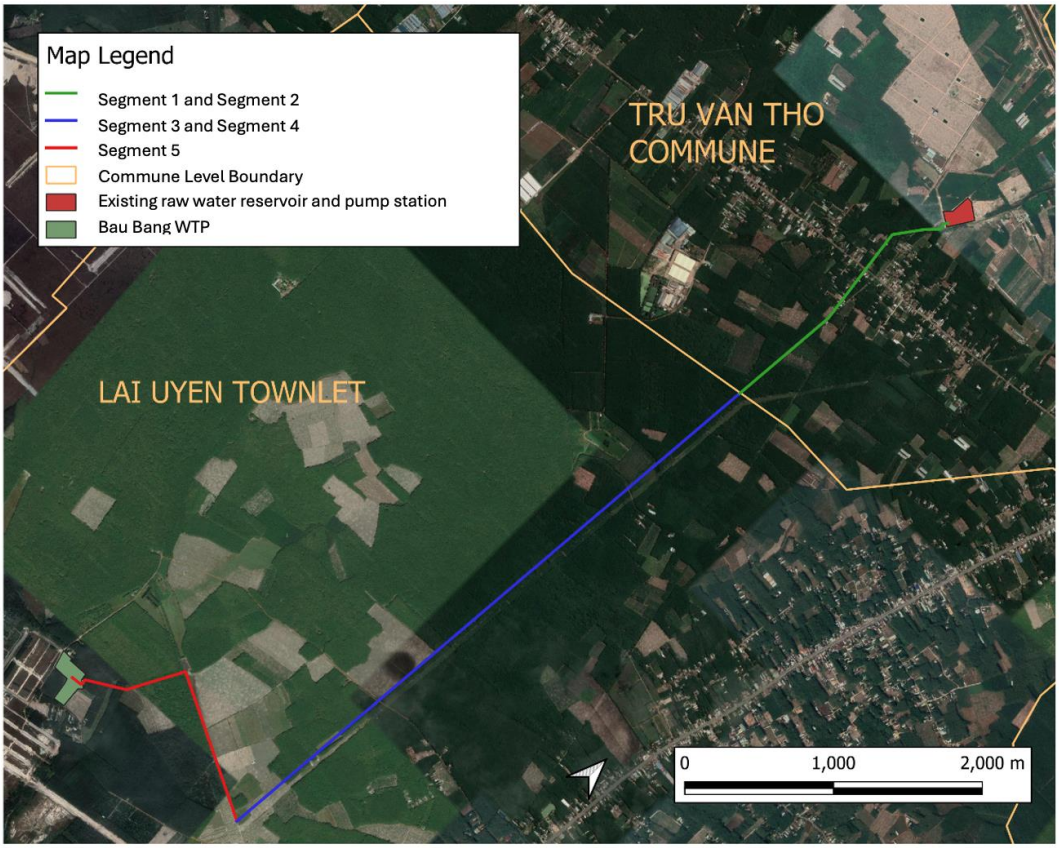


Figure 4-3: Proposed D1500 pipeline in three segments

The development status of this proposed D1500 pipeline is partially dependent on the agreement between TDM and EVN (owner of land under 110kV TL safety corridor). As Vietnam Electricity Company (EVN) will also have a plan to re-construct some 110kV electrical poles in 2024, the construction arrangement in segment is under development between EVN and TDM. Following Document No. 163/CPNTDM-KHKT dated 4th July 2023, TDM sent a request to EVN for surveying and agreement on the alignment of D1500 transmistal pipeline. Binh Duong Electricity Company (a subsidiary of EVN) allowed the establishment of Segment 1 and Segment 2 as per the agreement detailed in Document No. 4364/PCBD-AT, issued on 8 September 2023, regarding the Agreement on the Route of Laying Raw Water Transmission Pipeline in the High Voltage Power Grid Safety Corridor. The construction arrangements will be discussed between both

parties as EVN will implement upgrading of TL foundations under Segment 1 of the pipeline in 2024-2025 period.

In May 2024, the detailed pipeline alignment for Segment 1 was finalised by TDM's Decision No. 130/QD-CPTNTDM dated 21 May 2024 and TDM submitted an official document No. 131/CPNTDM-KHKT dated 22 May 2024 to Tru Van Tho Commune People's Committees (CPC) and Lai Uyen Town People's Committee (TPC) for approving the final alignment of Segment 1. Tru Van Tho CPC approved the final alignment of this segment in 08 July 2024 via document No.72/CV-UBND. For the pipeline segments located in Lai Uyen town, TDM submitted an official document No.134/CPNTDM-KHKT dated 27 May 2024 and received the approval from Lai Uyen TPC on the pipeline installation (according to the document No. 158/UBND-KT by Lai Uyen TPC dated 11 June 2024).

Bau Bang WTP Expansion

The coming expansion of Bau Bang WTP to 130,000 m^3/day as shown in Figure 4-4 is all within the existing Bau Bang WTP compound which land was acquired before the existing Bau Bang WTP construction in 2017, hence there is no change in the Bau Bang WTP site bondary. As observed during the site visit, this area is currently used for sludge drying within the existing Bau Bang WTP.

With the expansion work, existing water reservoir capacity at the pump station is sufficient, as water will be remained at the same level by controlling water intake flow and water pump flow. No additional reservoir is required. For upgrading to 80,000 m^3/day in 2025 the existing studies suggested upgrading items of the project as follows:

- Treatment Complex: Construct an additional treatment complex with a capacity of 80,000 m^3/day;
- Storage Tank: Build an additional storage tank with a capacity of 10,000 m^3;
- Secondary Pump Station: Retrofit and upgrade the existing secondary pump station and install additional pumps;
- Chemical and Chlorine Facilities: Construct additional chemical and chlorine facilities to meet the increased capacity of 200,000 m^3/day (including the equipment installing for the 50,000 m^3/day expansion);
- Transformer Substation: Increase the capacity to meet the additional load requirements;
- Electrical and Control System: Meet the demand for new construction items, with synchronous connections to existing components;
- Raw water Pump Station: Install additional pumps to meet the capacity of 60,000 m3/day;
- Supporting Infrastructure: Meet functional needs, usage requirements, and complete the project.

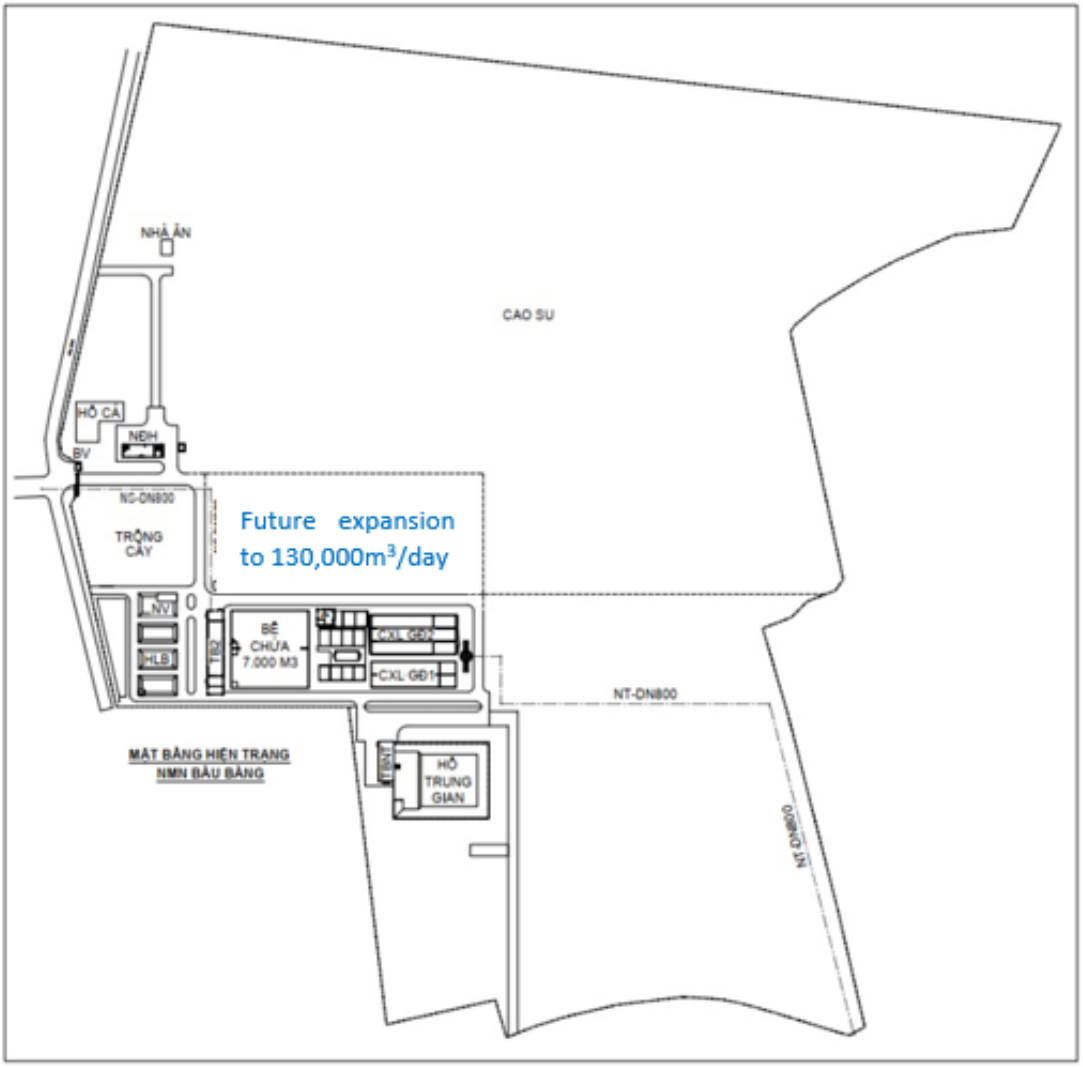


Figure 4-4: Location plan of additional 100,000 m³/day treatment complex including 2 stages – each stage of 50,000 m³/day

4.4 Analysis of Alternatives

4.4.1 NO-Project or Standalone Project Alternative

As Binh Duong is one of the most active provinces in Vietnam with the economic growth rate (GRDP) reached 5.97%[3] (2023), water demand has been considered as a significant resource to maintain the exceptional growth rate in future years. It is forecasted that by 2030, the water demand in Bau Bang district and Binh Duong province will be about 350,000 m³/day and 1,210,000 m³/day, respectively (FS, 2023).

The Bau Bang Area Water Supply System project has been invested, completed and put into operation in phase 1 with a capacity of 15,000 m³/day in 2017 and phase 2 with an increase of 15,000 m³/day in 2020, bringing the total capacity of the plant up to 30,000 m³/day to meet the water demand of the people and industrial sector in Bau Bang district. It is forecasted that the demand for treated water in the project area by 2030 will be 130,000 m³/day (FS, 2023). Bau Bang WTP is expected to play an on-site service role for the period till 2030, but from 2040 onwards, it will start a greater responsibility to transmit treated water to

[3] https://baoxaydung.com.vn/binh-duong-toc-do-tang-truo-ng-kinh-te-nam-2023-dat-597-365944.html

serve the other areas such as Ben Cat, Thu Dau Mot, Thuan An, Tan Uyen, etc in the water supply network of Binh Duong province.

The limited capacity (after phase 2 permanently upgraded in 2020) without an expansion project will cause the water scarcity for domestic and industrial purposes and challenge the development not only in Bau Bang area, but also in Binh Duong province. Considering from local authority perspective, Bau Bang expansion project is inline with the "Binh Duong province's planning for the 2021-2030 period, with a vision to 2050" approved by the Goverment in August 2024, even the expansion of existing project will lead to several adverse impacts to natural settings and local communities (which will be detailed in Section 6 of this report). Without the project, Binh Duong province will not be able to meet its increasing water demand, or a new water treatment plant will have to be constructed elsewhere with associated facilities e.g. water intake, pumping station, pipelines etc. It is considered more efficient and relatively less environmental impacts to expand the existing water treatment plant and utilize its associated facilities than building a new standalone facility.

4.4.2 Pipeline Alignment

Criteria for choosing a water supply pipe installation plan

To ensure the functional requirements of the pipeline and achieve the project's goals. The pipe installation plan must satisfy the technical, economic and aesthetic criteria and must conform to the following requirements:

- In line with the provincial master construction planning, the provincial water supply master plan.
- Suitable for the needs of residents in the area now and in the future.
- Ensure the water supply target and the function and role of the pipeline.
- Ensure the arrangement is synchronized with other planned underground works.
- The least impact on available works and urban beauty.
- Ensure convenience for the construction, installation and operation of the pipeline.
- Ensure the set goals with the most appropriate total investment.
- Limit special intersections (crossing through major roads, underground works, rivers, ponds).
- Minimize compensation and site clearance.
- Convenient for management (operation and maintenance).

Plan of pipeline installation

Initially, the total length of the pipeline is approximately 8.3 km with two options for alignment which are illustrated in the FS report 2023 and Decision No.130/QD-CPTNTDM. The alternative analysis of alignment was only considered for Segment 1 (from benchmark No.1 to benchmark No.36) where the D1500 pipeline will cross directly to a group of local community (Hamlet 2, Tru Van Tho commune).

- Option 1 is fully travelling under 110kV transmission line where there would be significant impacts on affected households (at least 5 households in the first 600 meters from which residential lands and temporary structures such canopies, roofs, short brick walls, sheds, and front yards will be destructed during the construction phase).
- Option 2 is mostly traversing along a natural stream (Bau Long stream) and public roads (TVT.39 and TVT.40 roads). This option was slightly changed due to the site constraints as upon engaging the EPC contractor (BIWELCO) and before commencing construction activities, the pipeline route

was finalized. This final route differed slightly from the alignment stated in Decision No.130/QD-CPTNTDM.

For segment 2, the available pressured pipeline D800mm carrying raw water from the primary pumping station to the treatment plant is located in the safety corridor of the power line (located to the right of the Vien Dong – Chon Thanh 110 KV transmission line). Approximately 4.5km of this segment will also travel along an upcoming 220kV power line. The edge of the pipeline is 2 meters from the outermost power line, so there is no more space for the installation of more pipelines D1500 mm along the available pipelines. After investigation, site visits and working with related units, the final alignment for the pipeline D1500mm under 110kV TL (from benchmark No.36 to benchmark No.144) will be located on the left side of the power line, and the pipe edge is 2 meters from the outermost power line as updated in 11 June 2024 (Figure 4-5). In segment 3, the pipe is placed along the boundary of the rubber forest, under the drainage ditch (from benchmark No.144 to the WTP, about 1.4 km long).

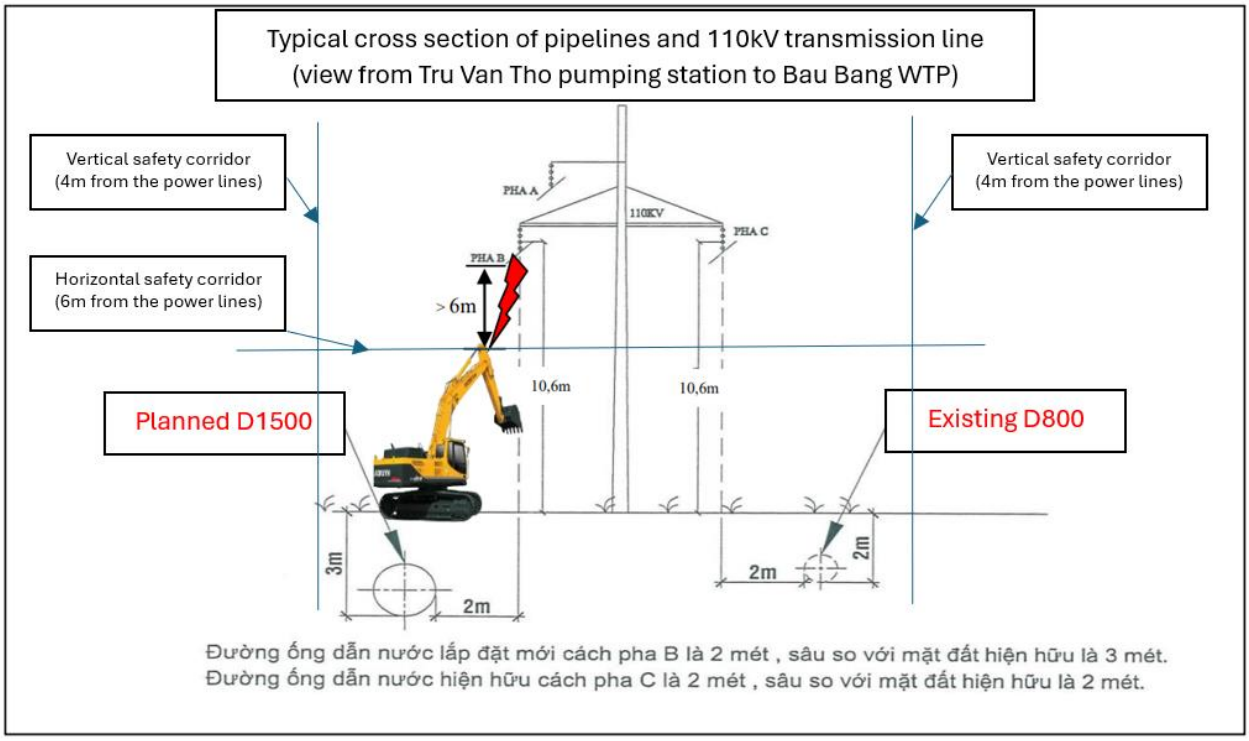


Figure 4-5: 110kV electrical safety corridor and transmisstal pipelines

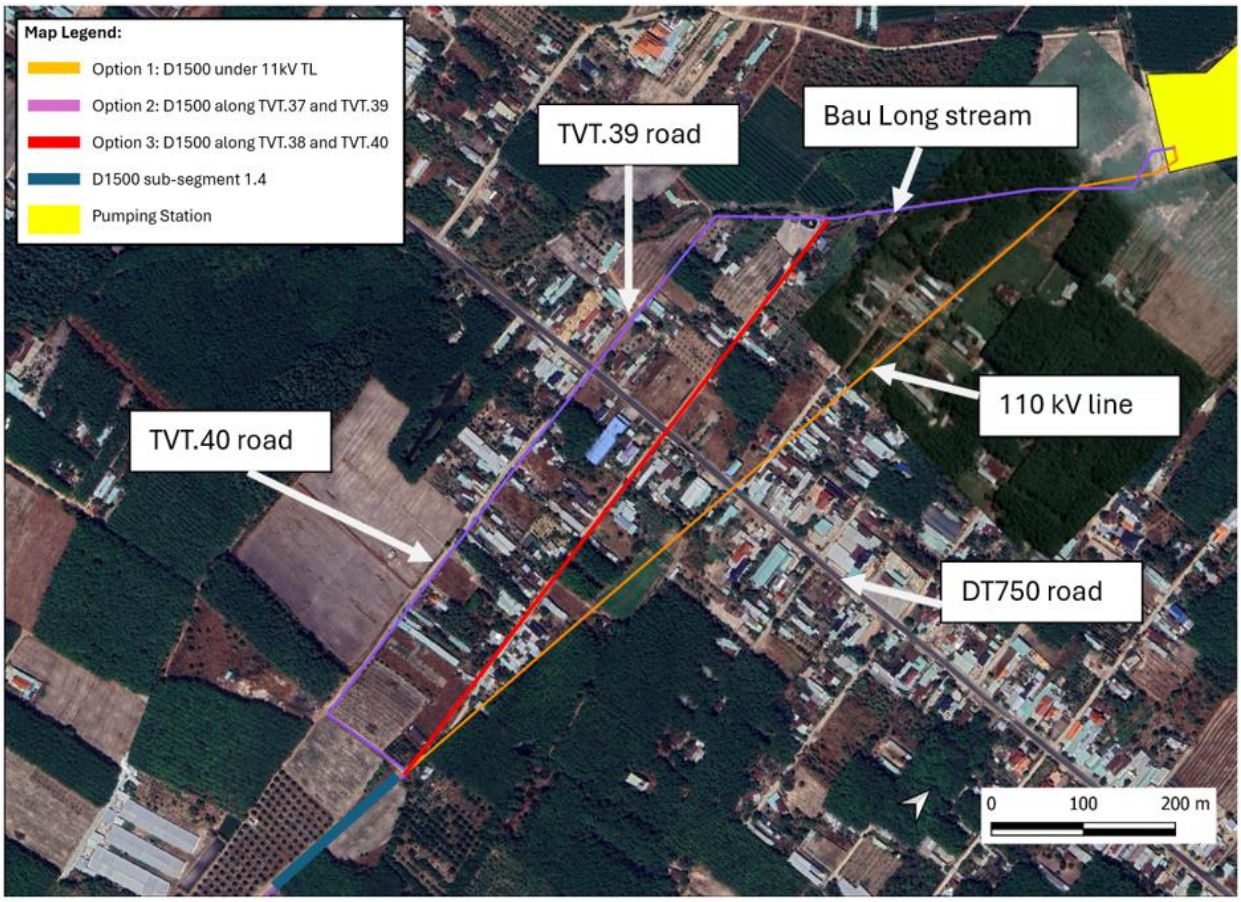
Current Status and final pipeline alignment

Upon engaging BIWELCO and before commencing construction activities, the route for the D1500 pipeline was finalized. This final route (Option 3) differed slightly from the alignment presented in Option 2 alignment. The final alignment is shown in Figure 4-7. The design of the final alignment (Option 3) is divided into five Segments, as presented below:

- Segment 1 – From Tru Van Tho Pumping Station along Bau Long Stream; Length (L) - 560 m
- Segment 2 – Pipeline along Road 39 and Road 40 to the 110 kV Power Line; L - 789m
- Segment 3 – Pipeline along 110kV Power Line; L - 785m
- Segment 4 – Pipeline along 110kV and 220kV Power Line; L – 4,457m
- Segment 5 - Pipeline From High Voltage Power Line to Bau Bang Water Plant; L – 1,401m

Option 2, with a length of 8.3 km, was based on Decision No. 130/QD-CPTNTDM (21 May 2024) comprised three segments. Slightly changed, the final alignment (Option 3) consisting of five segments and a total length of nearly 8.0 km, has received approval from the relevant People's Committees. Tru Van Tho Commune People's Committee approved the final alignment for Segments 1 to 4 on 8 July 2024 through document No. 72/CV-UBND. Segments 3 and 4 also fall under the responsibility of Southern Power Corporation – EVN, as per the agreement detailed in Document No. 4364/PCBD-AT, issued on 8 September 2023, regarding the Agreement on the Route of Laying Raw Water Transmission Pipeline in the High Voltage Power Grid Safety Corridor. For Segment 5, the Lai Uyen Town People's Committee issued approval for the pipeline installation on 11 June 2024 based on document No. 158/UBND-KT.

Figure 4-6 depicts all three alternative alignments of D1500 route. The alternatives of Option 1 and Option 2 pipeline alignment are detailed in Table 4-3 below. For the final alignment - Option 3, the detailed pipline length and number of affected household is presented in Table 4-4.



Notes:

- *Option 1 under FS report 2023*
- *Option 2 under Decision No.130/QD-CPTNTDM dated 21 May 2024*
- *Option 3 as final alignment in September 2024*

Figure 4-6: Alternative D1500 alignment

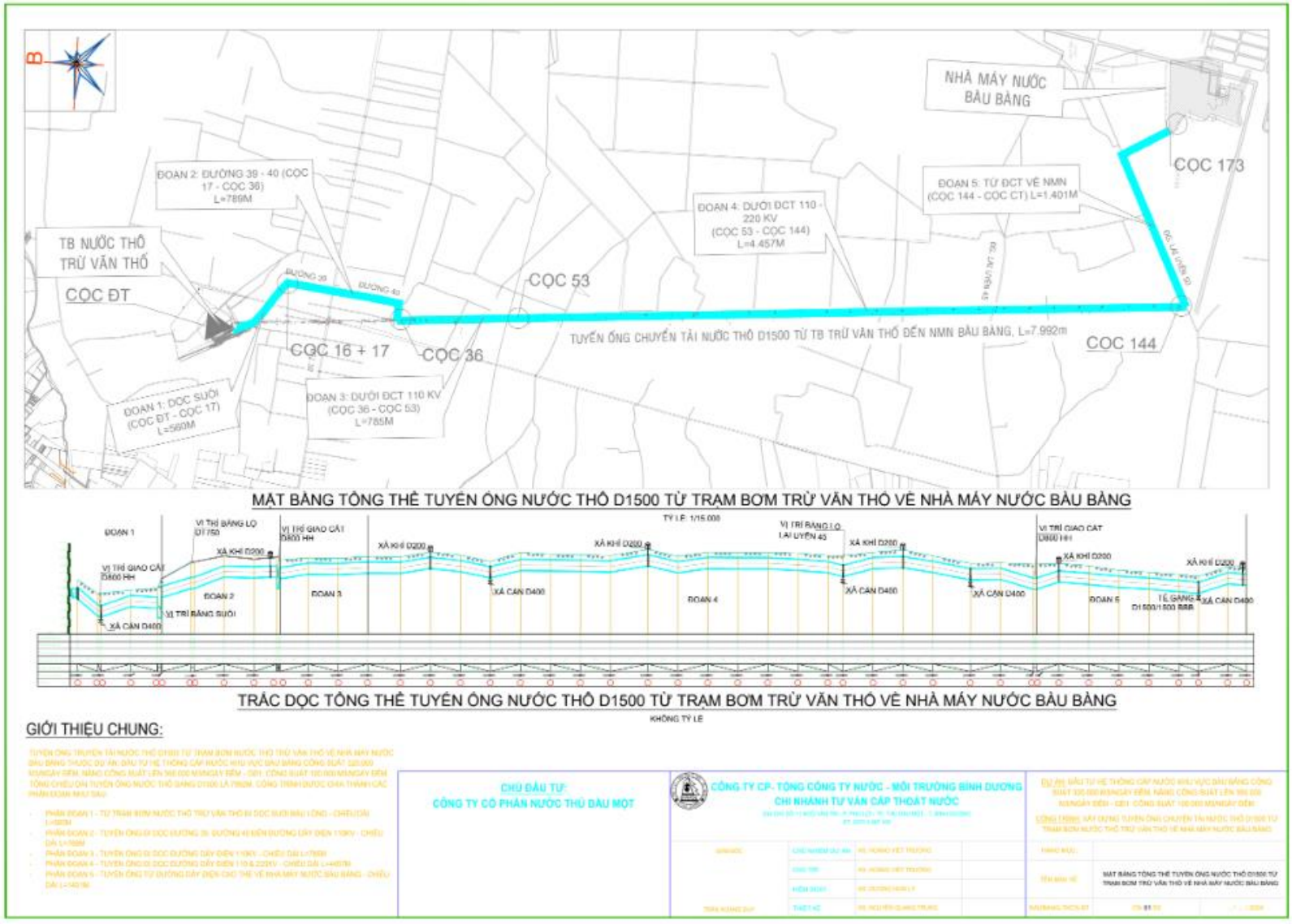


Figure 4-7: Final alignment of D1500 Pipeline (approved in September 2024)

Table 4-3: Alternative D1500 pipeline alignment

Segment/ Benchmark	Option 1: Feasibility Study 2023			Option 2: Decision No.130/QD-CPTNTDM dated 21 May 2024 (with alignment updates from Option 3)[4]		
	Alignment	Length (m)	Affected households	Alignment	Length (m)	Affected households
Segment 1: Pumping Station - Benchmark No.36						
Sub-segment 1.1	Completely under 110kV transmission line	6,300	At least 5 households with residential land and temporary structures in the first 600 meters from pump station before crossing DT750 (following Document No. 14/BC-CPNTDM-KHKT dated 1st December 2023) In addition, 19 households were identified by TDM as having land and assets within the 110kV TL safety corridor based on the agreement between TDM and AHs.	The pipeline will be installed along the safety corridor of the Bau Long stream to one local household (Hamlet 2 of Tru Van Tho commune).	551	Five (05) households affected by temporary land access
Sub-segment 1.2				The pipeline will run from one local household, along the centre of TVT.39 road to DT750.	196	This is a public road, and no household is affected by temporary land access.
Sub-segment 1.3				From DT750, the pipeline will extend along the road centre to the end of TVT.40.	582	No household affected by temporary land access.
Sub-segment 1.4				The pipeline will be installed in parallel with the existing pipeline D800 under the 110kV TL.	400	Five (05) households affected by temporary land access
Segment 2: Benchmark No.36 – No.144	Under 110kV transmission line		No information on number of affected households	The pipeline will be installed under 110kV TL.	4,852	11 households affected by temporary land access

[4] As updated by TDM in September 2024, the latest pipeline alignment will be implemented onsite slightly different from the routes settled by Decision No. 130/QD-CPTNTDM dated 21 May 2024. In other words, the pipeline alignment will cross the roads: TVT.39 and TVT.40, instead of TVT.37 and TVT.38 as specified in the Decision No. 130/QD-CPTNTDM.

Segment/ Benchmark	Option 1: Feasibility Study 2023			Option 2: Decision No.130/QD-CPTNTDM dated 21 May 2024 (with alignment updates from Option 3)[4]		
	Alignment	Length (m)	Affected households	Alignment	Length (m)	Affected households
Segment 3: Benchmark No.144 to Bau Bang WTP	Traverse along drainage ditch and rubber trees	2,000	No information on number of affected households	The pipeline traverses along drainage ditch (550m in length) and rubber plantation (1,000m in length)	1,417	One (01) household affected by temporary land access
Bau Bang WTP				Rubber trees within Bau Bang WTP boundary	About 300m	Bau Bang WTP boundary

Table 4-4: Final pipeline alignment - Option 3

Segment	Length (m)	Number of Affected Households
Segment 1	560	4
Segment 2	789	5
Segment 3	785	0
Segment 4	4,457	0
Segment 5	1,401	0
Total	**7,992**	**9**

4.4.3 Pipeline Material

Currently, the materials used for water supply pipes usually are the following three reliable materials: Steel pipes, ductile cast iron pipes and HDPE pipes. Comparison of the types of materials as follows:

Table 4-5: D1500 pipeline materials comparison

Criteria	Steel pipe	Ductile cast iron pipe	HDPE pipe
Resistant to impact and external loads	Highest durability	Very high durability	High durability but lower than steel and ductile cast iron pipes
Internal pressure resistance	10-16 Bar	10-16 Bar	10 Bar
Abrasion resistance	Higher than HDPE (+ +)	Highest (+ + +)	Lowest (+)
Corrosion resistance	Internal and external anti-erosion systems are required to protect pipe joints (+)	Good corrosion resistance (+ + +)	Weak resistance to organic solvents and UV light (+ +)
Joint method	Butt welded joint or flange	Socket welded joint with rubber gasket or compression joint. Concrete cushions are required at the reducer, tee, and bend	Welding Specialized welding equipment is required.
Length	6m	6m	6-9 m
Supply capacity	Common	Common	Less common
Cost	DN1500 Cheapest	DN1500 More expensive than steel pipes	DN1500 Most expensive
Handling and installation	- Required to weld joints by skilled welders. - It can take a long time to weld at the construction site (+)	Fastest and easiest installation (+ +)	Required to weld by special welding equipment and with quality control (+)
Application	Often used as water supply pipes at special locations. (+)	Often used as water supply pipes with big diameter (+ + +)	Often used as water supply pipes with small diameter ≤ 500 (+)

Criteria	Steel pipe	Ductile cast iron pipe	HDPE pipe
Lifespan	40 years	40 years	40 years
Comprehensive assessment	The material is cheaper but susceptible to chemical and electrochemical corrosion, the construction progress is slower than the cast iron pipe	The material is more expensive than steel pipe but the supply is more flexible and the construction schedule is faster.	Expensive materials, less common, slow construction progress
	(+ +)	(+ + +)	(+)
Notes: (+ + +): Very good, (+ +): Good, (+): Average			

With the above analysis, it is recommended to choose the pipe material which is **ductile cast iron pipe** to build the treated water transmission pipeline for the project.

4.5 Water Treatment Plant Design

4.5.1 Water Demand Projections

Bau Bang Water Treatment Plant Phase 1 was constructed and has been operating since 2017 with a designed capacity of 15,000 m^3/day. According to statistics, the output from 2018 to 2020 has an average growth rate of 100%/year. By 2020, Phase 2 received the investments for the timely production and full provision of treated water to meet the region's water demand with an additional designed capacity of 15,000 m^3/day. Thus, the existing WTP has a total capacity of 30,000 m^3/day, and is currently operating at its maximum capacity.

As mentioned in the previous section, Bau Bang Water Treatment Plant is planning to reach a capacity of 350,000 m^3/day by 2050, in which on-site service is the focus by 2030. From 2040 onwards, the focus will be on transferring treated water for water supply coordination for other areas in Binh Duong's water supply system such as Ben Cat, Thu Dau Mot, Thuan An, Tan Uyen, etc. The capacity expansion of 100,000 m^3/day until 2030 will be divided into two phases: (1) addition of 50,000 m^3/day by 2025; and (2) addition of 50,000 m^3/day by 2028.

According to the statistics on customer water consumption in 2018-2023 and the current first 2 quarters of 2024 (TDM, 2024), the 2024 water supply plan and Bau Bang Water Treatment Plant's capacity by 2030 are forecasted as follows:

Table 4-6: Growth of Bau Bang's supply capacity in the period of 2018-2023 with a forecast to 2030

Year	Raw water (m^3)	Treated water (m^3)	YOY Growth		Cumulative growth		Total		Treated water (m^3/day)
			Raw water	Treated water	Raw water	Treated water	Water flow (m^3 /day)	Growth	
2018	907,929	4,209,700	425%	173%	425%	173%	14,021	194%	11,533
2019	2,098,633	6,846,438	231%	163%	231%	163%	24,507	175%	18,757
2020	2,087,460	7,646,342	99%	112%	230%	182%	26,668	109%	20,949

Year	Raw water (m^3)	Treated water (m^3)	YOY Growth		Cumulative growth		Total		Treated water (m^3/day)
			Raw water	Treated water	Raw water	Treated water	Water flow (m^3 /day)	Growth	
2021	No information provided								
2022	2,064,087	9,831,414	212%	91%	227%	234%	32,590	101%	26,935
2023	1,789,531	9,234,214	87%	94%	197%	219%	30,202	93%	25,299
Expected output growth from 2024 to 2030									
2024	1,968,484	10,896,373	110%	126%	110%	126%	37,270	123%	31,877
2025	2,165,333	12,857,720	110%	126%	121%	159%	46,097	124%	40,165
2026	2,381,866	15,172,109	110%	126%	133%	200%	57,134	124%	50,608
2027	2,620,052	17,903,089	110%	126%	146%	252%	70,944	124%	63,766
2028	2,882,058	21,125,645	110%	126%	161%	318%	88,241	124%	80,345
2029	3,170,263	24,928,261	110%	126%	177%	400%	109,921	125%	101,235
2030	3,487,290	29,415,348	110%	126%	195%	504%	137,110	125%	127,556

Demand for both treated water and raw water is forecasted based on water supply in 2018-2023. From FS report (2023) and TDM's water supply plan (2024), the average growth rate of water usage in Bau Bang area for the period from 2024 to 2030 will be predicted as 25%/year with the total population estimated as 117,370 local residents (in 2023) and the 05 industrial zones and 01 industrial cluster with a total area of 4,956 hectares. The upcoming expansion Bau Bang WTP will provide a new pumping station to supply raw water for surrounding industrial parks (expected to supply 60,000 m^3/day).

As industrial parks are the core values which generate revenue for Binh Duong province, water supply infrastructure as part of core infrastructure facilities needs to be readily available in order to attract investment and expand to more industrial zones in the future.

4.5.2 Water Treatment Process of the Bau Bang WTP Expansion Facility

Similar to the existing Bau Bang WTP, raw water from the Phuoc Hoa canal is conveyed via two gravity flow pipeline (D1800 and D2500) to a reservoir at the pumping station, from which water is pumped to the expanded Bau Bang WTP for treatment via a proposed 8.0 km pressurized pipeline. At the WTP, the raw water undergoes various treatment stages, including a mixing tank, flocculation and sedimentation tank, settling tank, rapid filtration tank, storage tank, and a secondary pumping station that pumps treated water into the distribution network (see Figure 4-8). The treatment process for the expansion WTP is similar to the treatment process of the existing WTP.

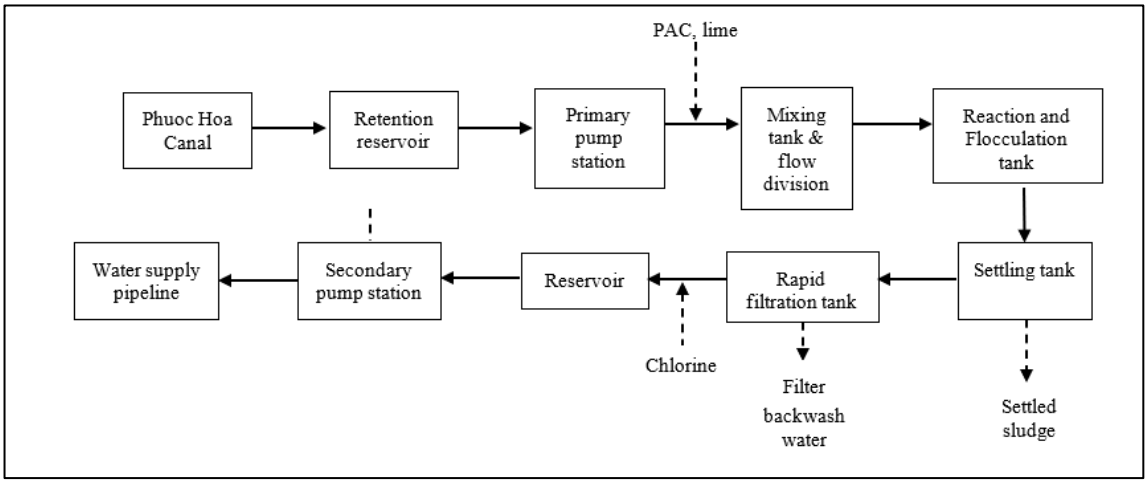


Figure 4-8: Bau Bang WTP treatment process (both existing and expansion WTP)

Treated water quality needs to be within limits of the Vietnamese Standard for Domestic Water Supply issued by the Ministry of Health (QCVN 01:2009/BYT and Circular No. 41/2018/TT-BYT). According to FS report (TDM, 2023), considering the quality of the raw water source from the Phuoc Hoa - Dau Tieng canal, the existing water treatment process adopted for the expansion WTP can treat the water to the required quality. The expansion WTP will be fully automated through the SCADA control system.

4.5.3 Bau Bang WTP Expansion Facilities Design Parameters

The Bau Bang WTP expansion facilities' designed parameters are summarised as below (Environmental Baseline Report, 2023) and the layout plan of the Bau Bang WTP expansion facilities is shown in Figure 4-9.

Table 4-7: Bau Bang WTP expansion facilities designed parameters

Unit	Capacity (m^3/day)	Quantity	Description	Dimension (m)
Mixing tank	200,000	01	Vertical mixing tank, the upper part is cylindrical, the lower part is truncated conical at an angle of 60°. Phase 1: 50,000 m^3/day; Phase 2: 100,000 m^3/day; Phase 3: 100,000 m^3/day (Phase 2 and Phase 3 are provision facilities).	Upper diameter = 6 m Lower diameter = 2.4 m Height = 7.5 m
Reaction-Flocculation tank	100,000	04	3 chambers with 4 distribution troughs per tank Phase 1: 50,000 m^3/day; Phase 2: 100,000 m^3/day (Phase 2 is a provision facility)	L x W x H =17.4 x 7.0 x 5.57
Settling tank (Sedimentation tank)	100,000	04	Phase 1: horizontal sedimentation tanks, without lamella settling pipes, with a capacity of 50,000 m^3/day. Phase 2: Installation of lamella settling tube according to US technology, with a 60° tilt settling tube, increasing the capacity from 50,000 m^3/day to 100,000 m^3/day	L x W x H = 36.0 x 7.0 x 5.57
Rapid filtration tank	50,000	12	Rapid filter tank of US technology, installing HDPE 2-layer filter underdrain .	L x W x H = 12.0 x 6.0 x 4.6
Storage tank	50,000	01	New tank volume = 10,000 m^3	L x W x H = 60.2 x 33.2 x 5.0
Secondary pump station (clean water pump station)	50,000	03	No construction works to be required, just installation works	Replacement of 03 pumps (Q = 500 m^3/h, H = 45m) by 01 pump (Q = 2,000 m^3/h, H = 45m) and 02 pumps (Q = 1,000 m^3/h, H = 45m)
Chemical House	50,000 (considered for 300,000)	01	PAC storage tank PAC and lime measuring and mixing system	L x W = 24.0 x 8.0
Chlorine House	50,000 (considered for 300,000)	01	To be constructed with neutralization system	Storage: L x W = 24.0 x 4.5 Reaction room: L x W = 4.5 x 3
Transformer station		01	Installed a new transformer to meet the upgraded capacity	3 phases / ,000 KVA

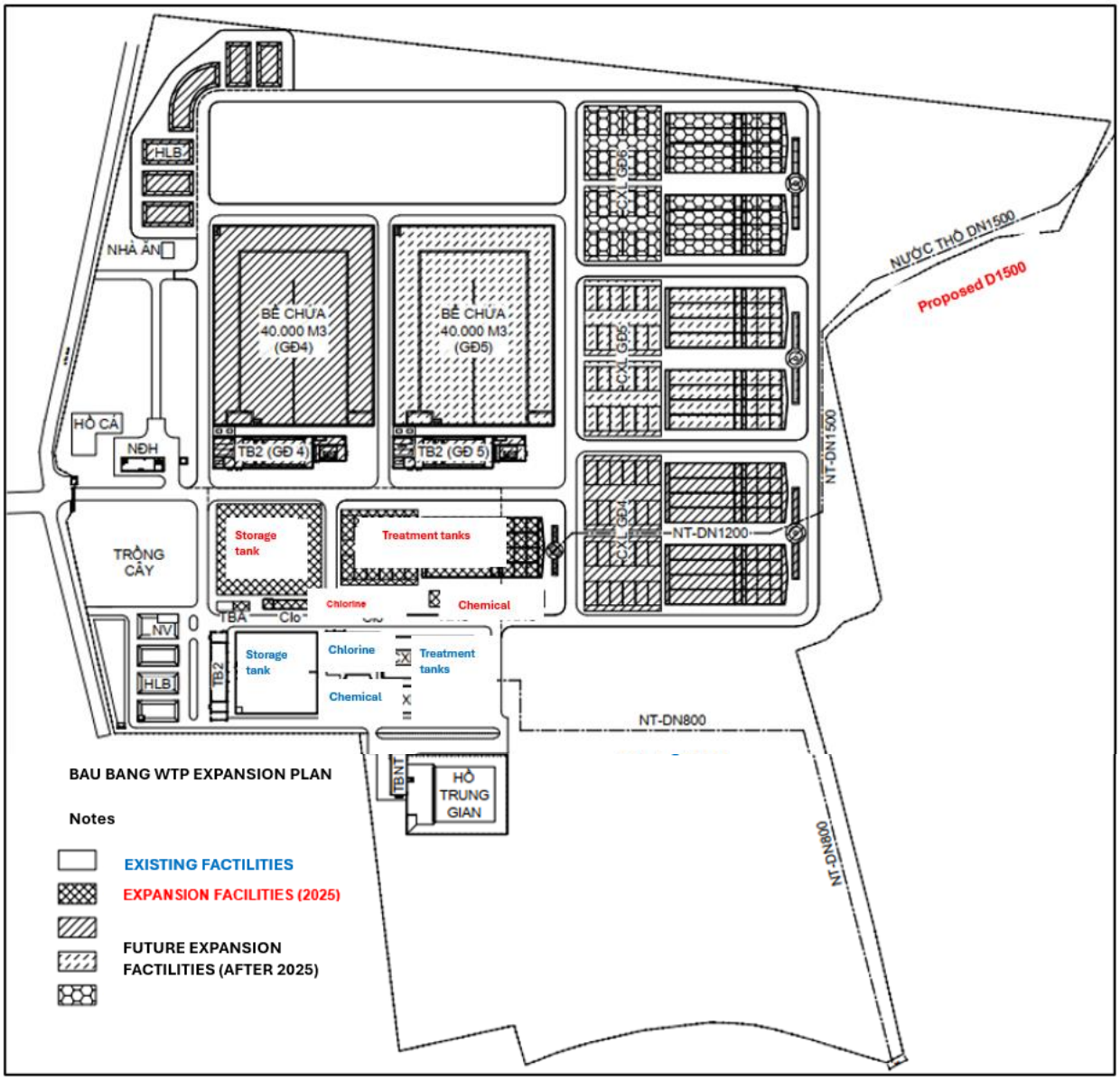


Figure 4-9: Bau Bang WTP expansion facilities layout (FS, 2023)

4.5.4 Construction Activities

Construction activities include the following:

- Vegetation clearance: Carry out clearing, cleaning and preparing construction sites for the entire land area within the project boundary. Clear the site and dig up tree stumps, tree roots, bushes, trash and discarded materials from the construction site.
- Grading and leveling: The leveling solution is based on the natural topography. Leveling materials use soil or river sand salvaged from excavation of facilities foundations.

- Equipment and materials preparation: Raw materials for the construction process come mainly from material suppliers in the locality where the factory was built as well as the surrounding area.
- WTP facilities construction works: New mixing tanks, reaction tanks, filtration tanks, storage tank, chemical and Chlorine houses to be constructed with total material needs are about 20,168 tons, including 6,218 m3 of concrete (14,992 tons of concrete) and 1,212 tons of iron and steel.

The construction equipment will be included:

- Crawler excavator
- Bulldozer
- Self-propelled drill hammer
- Car crane
- Self-propelled concrete pump truck
- Dump truck with load capacity of 10T
- Watering car
- Portable generator
- Mortar mixer
- Concrete compactors and compactors
- Electric welding machine
- Pipe cutting and grinding machine
- Handheld soil compactor
- Industrial fan
- Concrete air compressor
- Water pump

As updates in May 2024, the project is under bidding process to choose contractors and suppliers. The construction phase is expected to start in Quarter 3 2024 and complete in 2025 for trail operation before commercial operation in 2026. In the peak period of construction phase, it is expected to have around 100 employees onsite (EIA, 2024).

4.5.5 Routine Maintenance/ Operation Activities

As discussed with TDM, the workforce for operational phase is not finalized yet, however it is expected to perform the same organization chart as the operational team for Bau Bang existing project. The operation of Bau Bang WTP expansion facilities includes the following:

- 1 team managing the water intake and pumping station; and
- 1 team operating the Bau Bang WTP expansion facilities.

The Company's Rules and Working Guidelines (June 2020) for the Bau Bang WTP outline the requirements to be complied with during operation as follows:

- Ensure stable operation of the water treatment plant;
- Safety for both personnel and machinery/equipment;
- Compliance with legal regulations regarding the operation and management of water treatment plant;
- Safety in water supply, maintaining cleanliness and aesthetics;
- Staff members are well-trained and adhere to regulations to enhance work efficiency.

The daily operation activities include the following:

- To visual check security and safety of the compound of the facilities and the vicinity;
- To visual check the operation of the intakes, pipeline, pumping stations and other facilities at the pumping station, and check control room;

- To organize for regular housekeeping and cleaning of the water intake, water reservoir, pumps and other equipment;
- To monitor operation of the WTP via SCADA system in the control room;
- Raw water quality will be sampled and tested daily by TDM for main parameters such as pH and turbidity. Jar test will also be regularly carried out for coagulation and flocculation dosing, especially when turbidity of intake water turbidity increases. Treated water will also be sampled and tested weekly by the in-house laboratory of BIWASE.
- To organize with BIWASE and other third-party laboratories for water sampling and testing at the water reservoir and treated water.
- To visually inspect the site for compliance with EHS, fire safety, and other emergency responses on site etc.

Organisation chart of the Bau Bang WTP expansion facilities together with the existing WTP at operation stage is presented below.

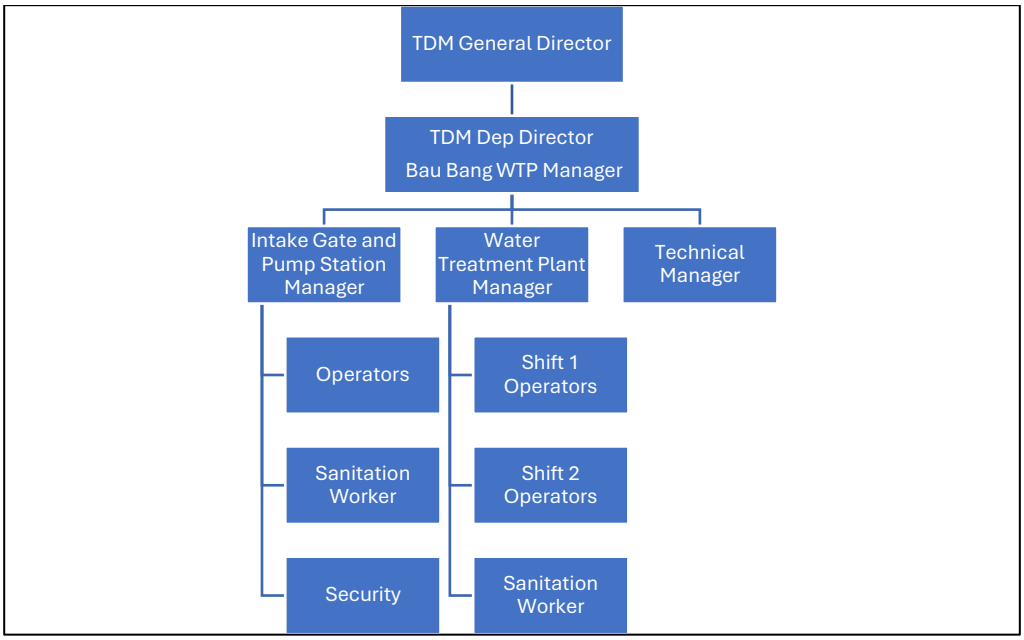


Figure 4-10: Bau Bang WTP and associated facilities organization chart

4.6 Transmission Pipeline Design

4.6.1 Pipeline Alignment

The detailed alignment of D1500mm pipeline is presented in Section 4.4.2 and **Table 4-4** as the proposed 8.0km pipeline is planned to be partly constructed within the safety corridor (4m from both sides of the alignment) of the existing 110kV electrical transmission line (TL). As the existing D800mm pipeline connecting from the Tru Van Tho pumping station to the existing WTP has occupied the left side of the safety corridor (view from Bau Bang WTP to Tru Van Tho pumping station), the middle section 5.24 km of the proposed 8.0km D1500mm pipeline will be laid within the safety corridor to the right of the TL (from the same view direction), from benchmark No.27 to benchmark No.144. The next segment from benchmark No.144 to the WTP for about 1.4 km long will be laid along the boundary of the rubber forrest and the earth drain before entering to Bau Bang WTP boundary.

Valves will be provided to release air and discharge sediment for the pipeline, including:

- Exhaust valve: Use automatic exhaust valve. The diameter of the exhaust valve is D200; and
- Discharge valve: Discharge tees are arranged at low points where the slope for placing pipe changes to flush before putting the pipeline into operation and to discharge the residue and drain completely during the operation of the pipeline. The diameter of discharge valve is D400.

4.6.2 Pipeline Construction Methodology

The construction of the pipeline will be rolling construction for each pipeline section, while another construction team will work on the WTP facility construction. Other pre-fabricated components at manufacturing plants are imported by the project and transported to the working area to prepare for construction. Carry out construction immediately to avoid loss and damage during on-site storage.

The open-cut method is proposed for the pipelines. Excavated areas will be along the pipelines (minimum 1m from edge from pipe) and the shaft for the pipe jacking works. The key activities, unching of pipe jacking machine, equipment and waste/slurry storage at the work site. The open-cut method involves the excavation of pipeline trenches, placement and welding of pipes followed by the backfilling of trenches, using excavated material.

The excavation and construction of the concrete ancillary structures along open-cut areas, such as Butterfly Valve Chambers, will follow similar construction sequence as the Open-cut methodology. The maximum size of excavation for chambers and sumps is 1m on all sides of the structures, and 0.3 m below the bottom level of the structure.

The ditch for placing pipeline is 2.2 m wide, with an average depth of 2.5-3.7 m. Backfill the excavated ditch with excavated natural soil and reinstate the surface relying on the available structure.

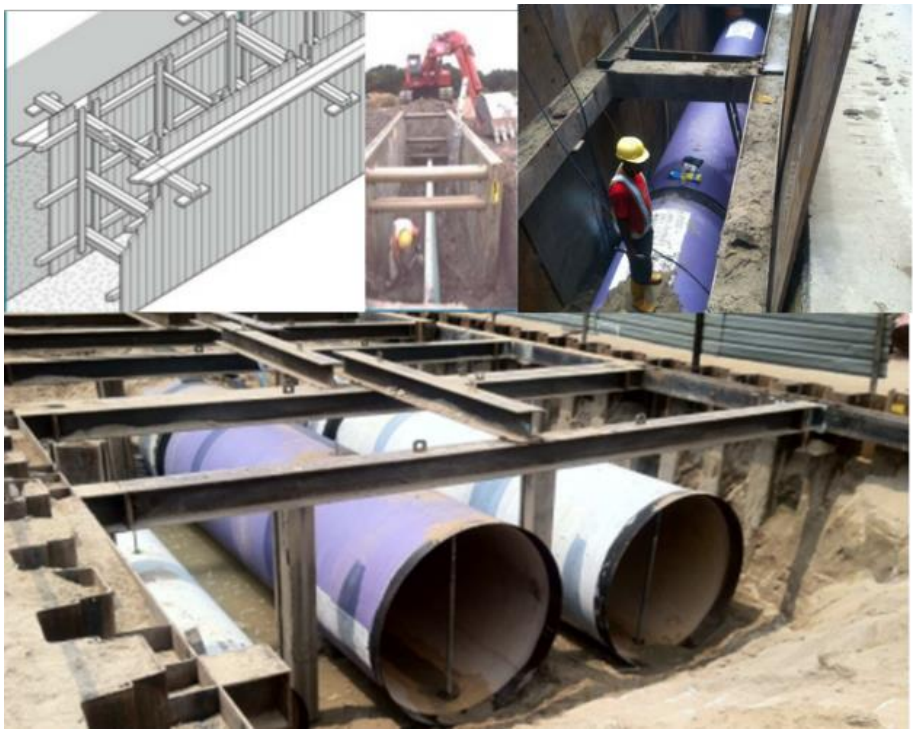


Figure 4-11: A typical open-cut pipeline construction mehod

4.6.3 Pipeline Construction Arrangements

The document No.4364/PCBD-AT is recorded as the latest agreement between TDM and EVN for the construction arrangement of D1500mm pipeline under the safety corridor of 110kV Vien Dong – Chon Thanh transmission line. TDM's Construction Contractor will be responsible for the construction and installation works of the pipeline and TDM's design consultant will be the contact point to finalize the technical design drawings, however following the document TDM will need to take the minimum requirements as:

- Sign a contract for electrical safety supervision with a qualified entity and establish necessary safety measures for construction in compliance with current regulations before commencing the project.
- Before starting construction, contact PCBD (representative of EVN in Binh Duong province) to conduct a site survey, determine construction methods, and obtain agreement before proceeding.
- When excavating for pipe installation, appropriate measures must be taken to prevent the subsidence of electrical grid and substation facilities as stipulated in Clause 7, Article 4 of Decree 14/2014/ND-CP dated February 26, 2014. Additionally, suitable safety measures must be implemented to prevent landslides and protect people from falling into the trenches, such as installing barriers, warning lights, and deploying guards when necessary, as specified in Section IV of Circular 39/2020/TT-BCT dated November 30, 2020, issued by the Ministry of Industry and Trade, regarding national technical regulations for electrical safety.
- During construction, the minimum distance from electrical conductors to the nearest point of equipment, tools, or vehicles operating within the safety corridor of the high-voltage power grid must always be maintained at 6 meters, as mandated by Clause 2, Article 10 of Decree 14/2014/ND-CP dated February 26, 2014.
- Throughout the construction process, continuous and ongoing supervision by the supervising unit and the operating management unit is required. In the event of any violation of safety distances resulting in accidents or disruptions to the power grid, the TDM and the construction unit (as TDM's Construction Contractor) will bear full responsibility before the law and will be liable for compensating any damages to the electricity sector and affected electricity consumers who file complaints.
- Regarding the agreement on allocating technical corridor land for the water pipeline, TDM is requested to contact the relevant state management authorities and landowners to obtain consent or compensation (if applicable) in accordance with regulations.
- Additionally, to avoid conflicts between pipeline project and the EVN upgrading project for of the 110kV Transmission Line PCBD requests that TDM and the design consultant for the D1500mm water pipeline contact Power Construction Consulting Joint Stock Company 3 (the design consultancy for the 110kV Transmission Line upgrading project and the Southern Power Project Management Board (representing EVN) to clearly define the corridor of the 110kV transmission line and the structural details of the new pole foundations for the construction of the DN1500 raw water pipeline in compliance with regulations.

As specified in the official letter No. 4364/PCBD-AN by PCBD, TDM sent an official document No.219/CPNTDM-KHKT dated 19 October 2023 to Power Construction Consulting Joint Stock Company 3 (the design consulting unit for the 110kV TL Project and 220kV Station in Ben Cat - Chon Thanh 220kV Station) and the Southern Power Project Management Board to clearly define the 110kV TL corridor and new TL foundation structure to construct the DN1500 raw water pipeline. However, no updates regarding this issue are available. While the detailed construction plan is still being developed, the TDM representative

has outlined a proposed approach. They plan to divide the pipeline construction into manageable sections, completing each section within a single day. This means excavation and pipe installation will occur simultaneously. At the end of the day, the excavated area will be temporarily levelled to ensure minimal disruption to local traffic. Once construction is complete in a section, TDM will restore the road surface with concrete.

On 01 July 2024, TDM entered into an Engineering, Procurement, and Construction (EPC) contract with BIWASE Construction – Electricity Joint Stock Company (BIWELCO), a subsidiary of Binh Duong Water Environment Corporation Joint Stock Company (BIWASE), an affiliate of TDM. Construction of the D1500 pipeline commenced on 30 September 2024, with an expected completion date of August 2025.

Before starting construction, TDM and BIWELCO completed a detailed measurement survey, Inventory of Losses, and compensation process to secure land access along the pipeline route. On 21-22 October 2024, ADB fielded a Staff Consultant (International Social Development Specialist) to conduct a preliminary audit of the ongoing land access acquisition and compensation process. Further reviews with the Environmental and Social (E&S) consultants and TDM for data validation were conducted through virtual discussions on 29 and 31 October 2024. The results of these reviews are discussed in the following sections.

The construction will also impact public infrastructure, including the TVT.39 road, the DT750 provincial road and the TVT.40 road. The construction work will occupy one side of the TVT.39 and TVT.40 roads and cross the DT750 road, which is anticipated to hinder local people's traveling. TDM will work only one side of the road at a time, allowing passage on the other side. Additionally, for residents of TVT.39, an alternative route is available through a nearby connecting alley. For the DT750 road, which is 12m wide, TDM will divide the road into two 6m sections. The excavation and installation will occur one side to another. Once the first half of the installation is completed, the road will be levelled temporarily using materials such as soil, sand, gravel, and concrete. TDM will pave the road with asphalt once the road condition is stable.

4.7 Project Schedule and Investment

Progress in implementing the main operational objectives of the investment project are included the following activities (starting from 2024):

- Survey, prepare construction investment feasibility study report, design construction drawings, appraise and apply for construction permit: 09 months.
- Contractor bidding and selection: 02 months.
- Construction, handover and commercial operation: upto 12 months.

The total investment is expected to be approximately 660 billion VND (EIA, 2024).

5. DESCRIPTION OF THE ENVIRONMENT

The baseline environmental surveys were carried out before May 2024, and the baseline socio-economic surveys were done in May 2024 by ESC when final alignment - Option 3 was not developed for the IESE report preparation (Option 3 was finalized in Sep 2024 after the Draft IESE was completed). As such, the surveys were done for Opion 2 alignment, so the description of the environmental and socio-economic baseline in this report is for Option 2 alignment. Should there be significant changes in the environmental, socio-economic baseline, TDM is to update accordingly to ensure compliance with ADB and JICA's requirements.

5.1 Project Area of Influence

According to ADB's SPS 2009, the area of influence encompasses:

- The primary project site(s) and related facilities that the borrower/client develops or controls. The primary project sites for this project include direct footprint of the Bau Bang WTP expansion structures and the 8.0km raw water transmission pipeline, construction area, laydown areas for material storage, site office/ worker dormes etc;
- Interfacing facilities that are not funded as part of the project which viability and existence depend exclusively on the project. The 110kV alignmnent is almost the same alignment with the 8.0km pipeline alignment. It is also understood that upgrading works for the TL with 7 poles along of the proposed pipeline will be constructed at the same time of the proposed pipeline alignment at this stretch. This 110kV upgrading project however is not considered as an associated facility of Bau Bang WTP expansion project but considered as interfacing work during construction;
- Effects from cumulative impacts from further planned development of the project, other sources of similar impacts. No cumulative impacts in this regard are anticipated as a result of this or similar projects;
- Effects from unplanned but predictable developments caused by the project that may occur later or at a different location. As a result of this project, it is anticipated that the development of the urban centers will continue, leading to further developments around the sub-project areas.

The area of influence i.e. the area which is affecfed by the project, also depends on the environmental impact being considered. Local impacts with a narrow area of influence are those impacts arising from noise, dust and other amenity issues. A larger area of influence results from impacts which contribute to global issues such as the embodied carbon associated with the manufacture, supply and use of concrete products, and the carbon emissions associated with material transport. ADB's SPS 2009 requires the assessment to identify potential transboundary effects, such as air pollution, and global impacts.

For the purposes of this IESE, the area of influence is taken to be the service area for the Bau Bang WTP expansion and the proposed 8.0km pipeline alignment. Following TCXD 33:2006/BXD – National Standard for Water Supply Distribution System and Facilities Design, the WTP's 30m buffer from the treatment facilities – (Article 11.24) and 300m buffer from Chlorine storage (Article 11.25) was recorded and also include a wider area estimated at 250m around the construction sites boundaries, as this is considered the distance to reach acceptable sound levels from construction equipment noise:

- WHO Community Noise Limits: One Hour LAeq 55 dBA (Outside; residential receptor, daytime limit);
- Construction Noise: Backhoe excavator 80 dBA at 15 m and concrete mixer 79 dBA at 15 m. Source: Construction Noise Handbook (www.fhwa.dot.gov), US Department of Transport;

- Noise attenuation factor: a conservative 6 dBA each time the distance from the point source is doubled [5] (Note that in soft vegetated environments such as in agricultural fields, the noise attenuation will be significantly increased meaning the area of influence could be narrowed); and
- Calculation: At 250 m the noise at a receptor is approximately 55 dBA (WHO limit).

During operations, the area of influence will also be linked to the discharge of effluents, and therefore encompasses the water body into which the treated effluent will be discharged.

5.2 Baseline Receptors

5.2.1 General Description of Bau Bang WTP expansion and associated facilities

The Bau Bang WTP expansion facilities is located within the existing Bau Bang WTP compound situated in Cay San hamlet, Lai Uyen commune, Bau Bang district, Binh Duong province. The raw water pump station and transmission pipeline span across two different communes: Tru Van Tho commune and Lai Uyen commune, both within the Bau Bang district. Generally, the location of Bau Bang WTP and its associated facilities (including intake gate and Tru Van Tho pump station) could be assessed as located in a remote area, far away from the residential area.

Figure 5-1: Affected area of Bau Bang WTP and associated facilities

[5] Source: US Occupational Safety and Health Administration (www.osha.gov/dts/osta/otm/new_noise/).

5.2.2 Receptors

Aquatic life along Phuoc Hoa – Dau Tieng canal where water intake structure get water through gravity flow concrete structure is identified as one of the sensitive receptors. Although the existing intake structure will not be upgraded, the structure was designed without any measures to prevent impacts on any potential aquatic fauna along the canal. IBAT report states that one of the EN fish triggering species, Poropuntius deauratus, has been found in the upstream catchment of Vinh Cuu Extension KBA that feeds into the Phuoc Hoa- Dau Tieng canal.

As observed during the site visit in August 2023, there is no residential recorded within the 0-300m buffer zone from the boundary of existing Bau Bang WTP compound in which the WTP expansion facilities is sited. There are about less than 10 households observed within the next buffer from 300m to 500m away from the existing Bau Bang WTP compound. There is also no residential in the vicinity of the Tru Van Tho pumping station. Basically both the Bau Bang WTP compound and Tru Van Tho pumping station are located in a new development area which is surrounded by empty lands, scrubs, vegetation and some planted rubber forests.

The proposed 8.0km D1500 pipeline traversed through five segments:

- Segment 1 and Segment 2 (approximately 1.35km): Tru Van Tho commune segment with the length of approximately 1.35km. Starting point is at Tru Van Tho pump station and traverse along Bau Long stream safety corridor (about 560m length), then spand along TVT.39 road, crossing DT750 provincial road, traverse along TVT.40 road (about 789m length) before traveling below the existing 110kV transmission line to the boundary line of Tru Van Tho commune and Lai Uyen town. No structures will be affected, only garden land (with fruit and vegetable) and production land (mainly rubber trees and cassava) from 9 affected households will need to be removed during the construction phase. This segment also crosses a Provincal Road (DT 750) that construction of the pipeline will cause potential impacts on traffic flow, nuisance from noise and dust to residents and road users.
- Segment 3 and Segment 4 (approximately 5.24km): this segment in Lai Uyen town will span under the 110kV TL (785m) and the 110kV and 220kV TLs (4,457m) before having a perpendicular turn to Segment 5. This segment is designed to be parallel with the existing D800 pipeline; The receptors could be expected as local farmers. However, no affected household was identified for this segment. The earth drain along the pipeline could also be impacted during construction due to excavation works.
- Segment 5 (approximately 1.4km): the final segment with 1.4km length will cross an area mostly covered by rubber trees then connect to Bau Bang WTP. Part of the pipeline is within the rubber tree areas built Bau Bang WTP compound that is belong to TDM. Some of the rubber trees along the pipeline alignment and construction area may need to be fell. However, no affected household was identified.

5.3 Topography and Geology

The current status of the planned land area is relatively flat, with elevation varying from +41.00 to +44.50. The land is very diverse and rich in types of soil:

- Top layer: dark gray arable soil, 0.4m-0.6m thick; layer of mixed clay, 1.4m-7.4m thick, hard plastic state; laterite clay layer of red-brown - yellow - gray-white color, 2.2m-3.8m thick, in hard plastic soil.

- The second layer is composed of sand mixed with quartz gravel, 2.4m-7.6m thick, plastic soil.
- The third layer is composed of clay, 1.2m-11.9m thick, semi-hard soil.

According to the Feasibity Study (TDM,2023), the geological survey conducted for the project development indicates that the foundation geology in the area is favorable with the compressive strength is measured at over 2 kg/cm². Although the FS did not elaborate any more geology information from that geological survey.

5.4 Meteorology and Climate

The project is located in an area with a typical climate of a sub-equatorial region with 2 distinct seasons: the rainy season from May to November and the dry season from December to April of the subsequent year. The weather - climate characteristics of the project area are detailed below using data observed at So Sao meteorological station in the period of 1995-2010.

Air temperature

The air temperature has a direct effect on the conversion and dispersion of pollutants in the atmosphere. The higher the air temperature is, the faster the rate of chemical reactions and the shorter the lasting time of pollutants is. The temperature variation affects the dispersion of dust and emission gas, as well as the heat exchange of the human body and thereby the health of workers.

The average annual air temperature is high and stable throughout the year and months. The temperature variation between the hottest month and the coldest one is about 4.6 o C. However, the daily temperature variation is quite high, about 10oC. Summary of air temperatures of the Project Site is as follows:

- Average annual air temperature: 26.7 o C
- Absolute maximum temperature : 39.5 o C
- Absolute minimum temperature: 16.5 o C
- Air temperature in the hottest month (May): 29.5 o C
- Air temperature in the coldest month (February): 24.9 o C

Number of sunlight hours

- Average hours of sunlight per year: 2,340 hours
- Average hours of sunlight per day: 6.4 hours
- Average number of sunlight hours per day in the highest month: 8.3 hours
- Average number of sunlight hours per day in the lowest month: 3.5 hours

Solar radiation

The solar radiation is one of the important factors that directly affects the thermal regime and thereby affects the stability level of the atmosphere and the dispersion and transformation of pollutants. The solar radiation directly changes the temperature of an object depending on its capacity to reflect and absorb the radiation such as coating surface, paint color, surface properties, etc. The average total annual radiation is about 150 kcal/cm2, and the average total daily radiation is about 480 cal/cm2 at the Project Site.

Rain

The rain will also affect the air quality. The rain will wash away dust and pollutants in the atmosphere as well as those on the ground where the rainwater flows through. The quality of rainwater depends on that of the atmosphere and the environment in the area.

The rainy season lasts from May to November, accounting for 85-95% of annual rainfall. The highest rainfall is in September with 400 mm and more.

- Number of rainy days per year : 113 days
- Average rainfall per year : 1,780 mm
- Highest annual rainfall: 2,680 mm
- Lowest annual rainfall: 1,136 mm

Relative air humidity

Together with the air temperature, the air humidity is one of the natural factors that directly affect the conversion and dispersion of pollutants in the atmosphere, the heat exchange of the human body and thereby the health of workers.

- Average annual air humidity : 82%
- Minimum air humidity : 72% (in March)
- Maximum air humidity : 91% (in September)

Evaporation

- Average daily evaporation : 3.5 mm/day
- Maximum daily evaporation : 6.05 mm/day
- Minimum daily evaporation : 1.97 mm/day

Wind

Wind is an important factor for the dispersion and propagation of pollutants in the atmosphere. The higher the wind speed is, the further the wind spreads dust and pollutants, and the higher the probability of diluting them with clean air.

The wind is relatively stable, and not affected directly by tropical typhoons and depressions. In the rainy season, dominant wind directions are West, Southwest; in dry season, dominant wind directions are East, Northeast and Southeast. The annual average wind speed is 0.67 m/s.

5.5 Climate Change Projections

According to the World Bank's Climate Change Knowledge Portal for Vietnam[6], Vietnam has been ranked among the five countries likely to be most affected by climate change. It has been estimated that climate change will reduce national income by up to 3.5% by 2050.

In order to provide climate change projection information, in 2013 the Intergovernmental Panel on Climate Change (IPCC) developed and published a new set of climate change scenarios, called RCPs (Representative Concentration Pathway). The four RCPs (RCP2.6, RCP4.5, RCP6 and RCP8.5), are named after a possible

6 https://climateknowledgeportal.worldbank.org/sites/default/files/2021-04/15077-Vietnam%20Country%20Profile-WEB.pdf

range of radiative forcing values in the year 2100 relative to preindustrial values (+2.6, +4.5, +6.0 and +8.5 W/m2, respectively). Climate change for Vietnam in general and for Binh Duong Province in particular issued by (MONRE, Updated 2020)[7] is presented in details below.

5.5.1 Temperature

For the RCP4.5 scenario, by the middle of the 21st century, the average annual temperature across the country is expected to increase generally in the range of 1.2 to 1.7°C. Specifically, in the Northern regions, the increase is projected to be in the range of 1.6 to 1.7°C, while in the Southern regions, it is expected to be in the range of 1.2 to 1.3°C. By the end of the century, the temperature is projected to rise between 1.6 to 2.4°C, with the Northern regions experiencing an increase predominantly above 2.0°C and the Southern regions showing an increase generally below 1.8°C. The minimum increase is expected in some areas of the extreme Southern Central Vietnam, Southern Vietnam, and island stations.

Temperature increase for Binh Duong Province for the RCP4.5 scenario is projected to vary between 0.9 and 2.0°C in the beginning of 21st Century, 1.1 and 2.6°C by end of the 21st Century. For the RCP8.5 scenario, the Province is projected to vary from 1.3 to 2.6°C in the beginning of 21st Century and from 2.6 to 4.7 °C by the end of 21st Century (Table 5-1).

Table 5-1: Annual mean temperature (°C) projection for the 21st Century (MONRE, 2020)

	RCP 4.5		RCP8.5	
Period	2046-2065	2080-2099	2046-2065	2080-2099
Whole country	1.2 ÷ 1.7°C	1.6 ÷ 2.4°C	1.7 ÷ 2.3°C	3.2 ÷ 4.2°C
Northern region	1.6 ÷ 1.7°C	above 2.0°C	above 2.0°C	3.8 ÷ 4.2°C
Southern region	1.2 ÷ 1.3°C	below 1.8°	below 2,0°C	3.2 ÷ 3.5°C
Binh Duong Province[8]	1.3 (0.9 ÷ 2.0)	1.8 (1.1 ÷ 2.6)	1.9 (1.3 ÷ 2.6)	3.4 (2.6 ÷ 4.7)

5.5.2 Rainfall

According to the RCP4.5 scenario, in the 21st century, the annual precipitation tends to increase nationwide, with a common increase of 10 to 15% by mid-century and 10 to 20% by the end of the century. Under the RCP8.5 scenario, by the mid-21st century, the annual precipitation tends to increase by 10 to 15% across most of the country, and in island stations and coastal areas in the Northeast region, precipitation may increase by 20 to 30%. There is a tendency for a slight decrease in precipitation in some areas of Lao Cai and Ha Giang provinces, with a decrease generally below 5%. By the end of the century, precipitation tends to increase nationwide, with a common increase of 10 to 25%. In some areas of the Northeast region, precipitation may increase by over 40%.

Rainfall in Binh Duong Province forecasted to increase betweent 3.1-29.8% in the beginning of 21st Century, 4.9-27.1% by end of the 21st Century. For the RCP8.5 scenario, the Province rainfall is projected to increase from 5.8 to 27.8% in the beginning of 21st Century and from 16.6 to 38.0 % by the end of 21st Century (Table 5-2)

7 https://vnmha.gov.vn/upload/files/kich-ban-bien-doi-khi-hau-phien-ban-cap-nhat-nam-2020.pdf

8 The values within parentheses represent the range of variation around the mean value, with a lower limit of 10% and an upper limit of 90%

Table 5-2: Annual delta rainfall (%) projection for the 21st Century (MONRE, 2020)

	RCP 4.5		RCP8.5	
Period	2046-2065	2080-2099	2046-2065	2080-2099
Whole country	10 ÷ 15%	10 ÷ 20%	10 ÷ 15%	10 ÷ 25%
Binh Duong Province[9]	16.7(3.1 ÷ 29.8)	15.2(4.9÷27.1)	17.0(5.8÷27.8)	24.1(16.6÷38.0)

5.5.3 Tropical depressions and typhoons

According to (MONRE, 2016), over the period from 1959 to 2015, Vietnam's East Sea experienced an average of around 12 tropical depressions and typhoons annually. Among these, seven depressions and typhoons impacted Vietnam, with five making landfall on Vietnam's mainland. During the same period, tropical depressions and typhoons displayed an increase in intensity and a tendency to last longer while moving southward. MONRE predicts a slight reduction in the number of tropical depressions and typhoons under the RCP4.5 and RCP8.5 scenarios throughout the 21st century.

Meanwhile, the simulated results from PRECIS model indicate a decreasing trend in the number of storms and tropical depressions in the Vietnamese East Sea during the early typhoon season months (June, July, August) in both the RCP4.5 and RCP8.5 scenarios. However, there is an increasing trend towards the end of the typhoon season, particularly in the RCP8.5 scenario. Therefore, the activity of storms and tropical depressions tends to shift towards the late typhoon season, a period when storms are predominantly active in the southern regions.

5.5.4 Extreme weather events

According to (MONRE, 2020), the number of days with intense cold and harmful cold in North Vietnam and Central North Vietnam both show a decreasing trend. The number of sunny days and days with intense heat tends to increase across most of the country, with the greatest increase in North Central Vietnam, Central South Vietnam, and South Vietnam.

The number of dry months during the dry season tends to increase over most areas nationwide, with a decreasing trend in some areas of Northwest Vietnam, Central Vietnam, and the extreme southern part of South Vietnam. Droughts in Vietnam are expected to intensify in the future due to rising temperatures and reduced rainfall during the dry season. The number of hot days (with temperatures ≥ 35ºC) is projected to reach 35 - 45 days per year by the middle of the 21st century and is anticipated to surpass 100 days per year by the end of the 21st century.

5.5.5 Impact of Climate Change to the Project

The potential impacts of climate changes affected to water supply and water treatment include:

- Warmer temperatures resulting from climate change can adversely affect water supply and treatment process. Elevated temperature in the water columns due to climate change can lead to increased evaporation resulting to disrupting water availability. Moreover, changes in chemical balances may occur due to elevated water temperature, contributing to increased eutrophication, further compromising water quality. The changes of water source availability or water quality will

9 The values within parentheses represent the range of variation around the mean value, with a lower limit of 20% and an upper limit of 80%

pose challenges to the treatment process and increased operating challenges to meet the standards.

- The anticipated rise in the frequency and intensity of extreme weather events presents potential risks to water-related infrastructure. This includes an increased threat of direct flood damage to crucial components such as pumping station, water reservoir, and the Bau Bang WTP. Moreover, these extreme weather events may lead to changes in both the quantity and quality of watershed runoff. This alteration in runoff dynamics can result in shifts in non-point source pollution loads entering receiving waters, or increased turbidity and pollutants from upstream catchment due to heavy downpour, thereby impacting water quality and introducing challenges to the effective operation of water treatment processes.

5.6 Hydrology, Flooding and Other Natural Disasters

5.6.1 Hydrology

The surface water resources in Binh Duong Province are abundant, given the province's proximity to significant rivers and water bodies such as the Song Be in the East, the Dong Nai River in the southeast, and the Sai Gon River in the west. Furthermore, the hydrological scheme in the region intricately combines natural and artificial components to sustain water resources for domestic and irrigation purposes.

In particular, the raw water supply for the Bau Bang WTP is sourced from the Phuoc Hoa – Dau Tieng canal. With a designed capacity of 75 m3/s, The Phuoc Hoa – Dau Tieng canal facilitates the controlled transfer of water from the Phuoc Hoa reservoir in Binh Phuoc province to the Dau Tieng reservoir in Tay Ninh province (Figure 5-2). This deliberate water transfer ensures a plentiful water supply for domestic and irrigation needs in the downstream areas of the Sai Gon and Vam Co rivers, especially during the dry season. The management of this canal falls under the oversight of the Dau Tieng - Phuoc Hoa Irrigation Exploitation Company Ltd, operating under the auspices of the Ministry of Agriculture and Rural Development (MARD).

In the local hydrology context, there are two small streams in the area, namely:

- The Ben Van stream to the West, originating in Lai Uyen commune, traversing Lai Uyen, merging with Dong Co stream, proceeding to Ba Lang stream, and ultimately joining Thi Tinh river. The initial segment of Ben Van stream within Lai Uyen is narrow with minimal water flow during the dry season.
- To the South, a small stream originates at Hamlet 5 in the Bau Bang area. This stream is obstructed at Cau Sat, creating a reservoir spanning approximately 5-8 hectares.

However, the meager flow from these streams is insufficient to meet the water demands of local industrial and urban development. Meanwhile, groundwater storage in the area is seen relatively abundant, as evidenced by wells drilled to supply water to existing industrial facilities. However, specific documentation regarding the groundwater of the area is not available.

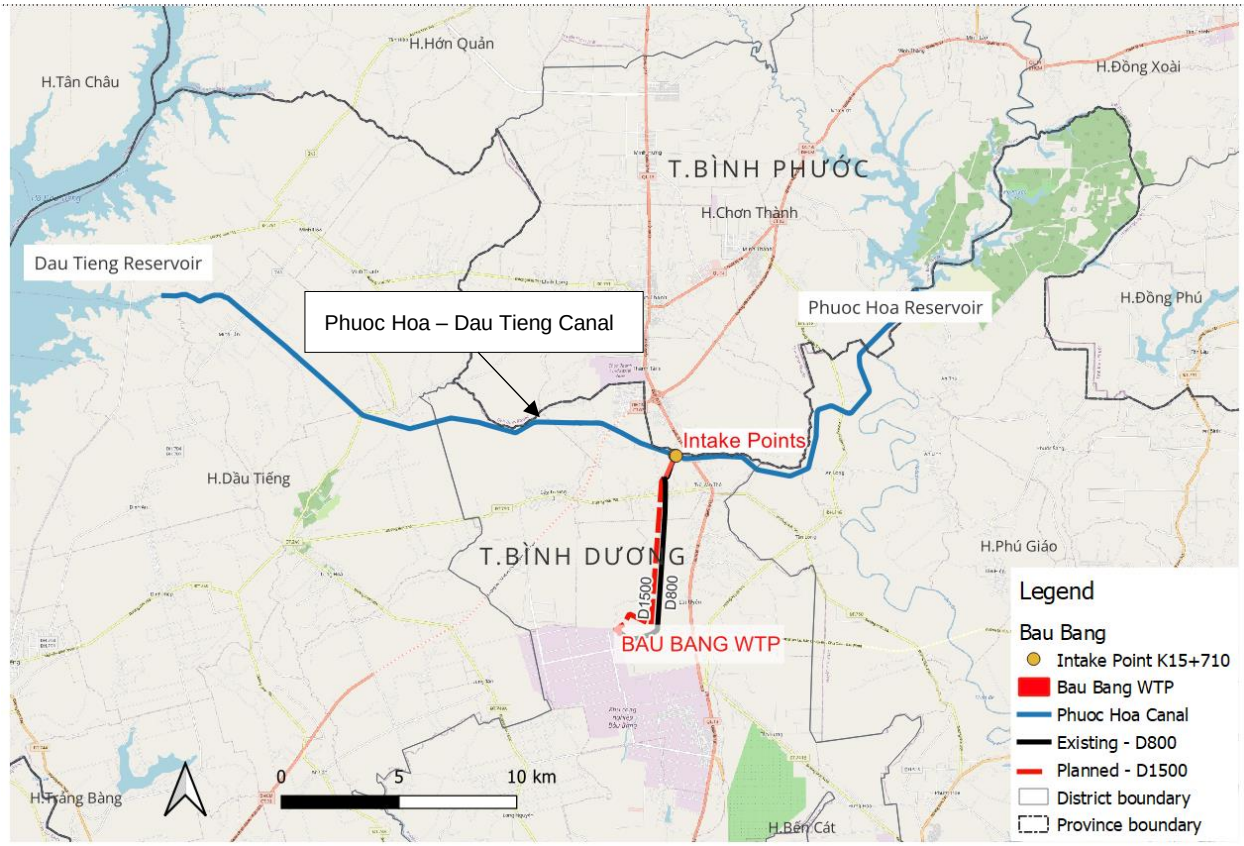


Figure 5-2: Project location and proximity to Dau Tieng – Phuoc Hoa canal

5.6.2 Flooding

As reported by Binh Duong Department of Science and Technology10, flooding in Binh Duong has been a recurring issue over the years, stemming from various causes, with the most significant being heavy rainfall, tidal surges, and flooding from the river. The annual flood season typically extends from May to October, coinciding with the monsoon rains, followed by the tidal surge period from October to January of the following year. The frequency of heavy rainfalls has been gradually increasing over the past decades. Concurrently, the drainage system is undergoing improvements but is not yet fully capable, with many areas in the province lacking a comprehensive drainage system. Consequently, urban flooding due to rain has become more frequent. Notably, the situation is exacerbated by the increasingly complex patterns of stormy weather, with higher frequencies and intensities of cySMnes and tropical depressions occurring in the Binh Duong region, the Saigon River basin, and the Dong Nai River.

The primary causes of flooding along the main riverbanks are releases from upstream reservoirs and tidal surges. Flooding in the tributary areas is mainly due to rainfall, but the frequent occurrence is also influenced by narrowed and dried-up streambeds. In urban areas, inadequate drainage system construction and/or insufficient culvert capacity are the major factors contributing to flooding. Through analysis, three predominant natural factors affecting flooding in the Binh Duong province are localized rainfall, tidal surges

10 http://sokhcn.binhduong.gov.vn/New/ung-dung-he-thong-thong-tin-dia-ly-gis-phuc-vu-cong-tac-phong-chong-ngap-lut-tren-dia-ban-tinh-binh-duong-2361

at river mouths, and water releases from the Trị An, Dau Tieng, and Phuoc Hoa reservoirs in the upper reaches.

5.7 Water Quality

5.7.1 Surface Water Quality

To determine the environmental baseline for surface water, the regulatory survey (EIA, 2024) conducted surface water for Bau Bang expansion project. The sampling campaigns were done in accordance with QCVN 08:2023/BTNMT. Five surface water samples (NM.003 to NM.007) were collected from upstream and downstream of Phuoc Hoa – Dau Tieng canal and a natural flow on the transmission pipeline from Tru Van Tho pump station to Bau Bang WTP. The coordinates of sampling location and analysis results are presented in Table 5-3.

The laboratory analysis results indicated that the baseline water quality of the Phuoc Hoa – Dau Tieng canal and the surrounding natural water stream is in good condition. Four out of five sampled locations (NM.003, NM.004, NM.005 and NM.006) were categorized as in good quality (Class A) which are suitable for use in treatment for domestic water supply acccording to QCVN 08:2023/BTMNT[11], the National Technical Regulation on Surface Water Quality. Only location NM.007 was categorized as average quality (or class B) but NM.007 is not from the Phuoc Hoa – Dau Tieng canal.

However, the iron concentration in all five locations was found relatively high compared to the QCVN 08:2023/BTMNT applied for surface water quality. The elevation of iron level in surface water may occur due to various natural and anthropogenic activities. Given that the Phuoc Hoa – Dau Tieng canal is part of a irrigation system, it is likely that the iron contamination comes from the use of iron-containing fertilizers or pesticides in agriculture fields nearby and is brought to the water bodies via storm water runoff.

Table 5-3: Surface water sampling location

Sample No.	Sampling date	Location	WGS84 coordinate	
			Lattitude	Longitude
NM.003	12 October 2023	Intake gate (at point K15+710 Phuoc Hoa – Dau Tieng canal)	11.358470	106.626233
NM.004	12 October 2023	500m upstream from NM.003	11.358183	106.628367
NM.005	12 October 2023	1000m upstream from NM.003	11.357769	106.630940
NM.006	12 October 2023	500m downstream from NM.003	11.360125	106.622986
NM.007	23-24 November 2023	Earth drainage near proposed D1500 8.0km pipeline	11.3444647	106.620458

11 https://datafiles.chinhphu.vn/cpp/files/vbpq/2023/3/01-btnmt-qc08.pdf

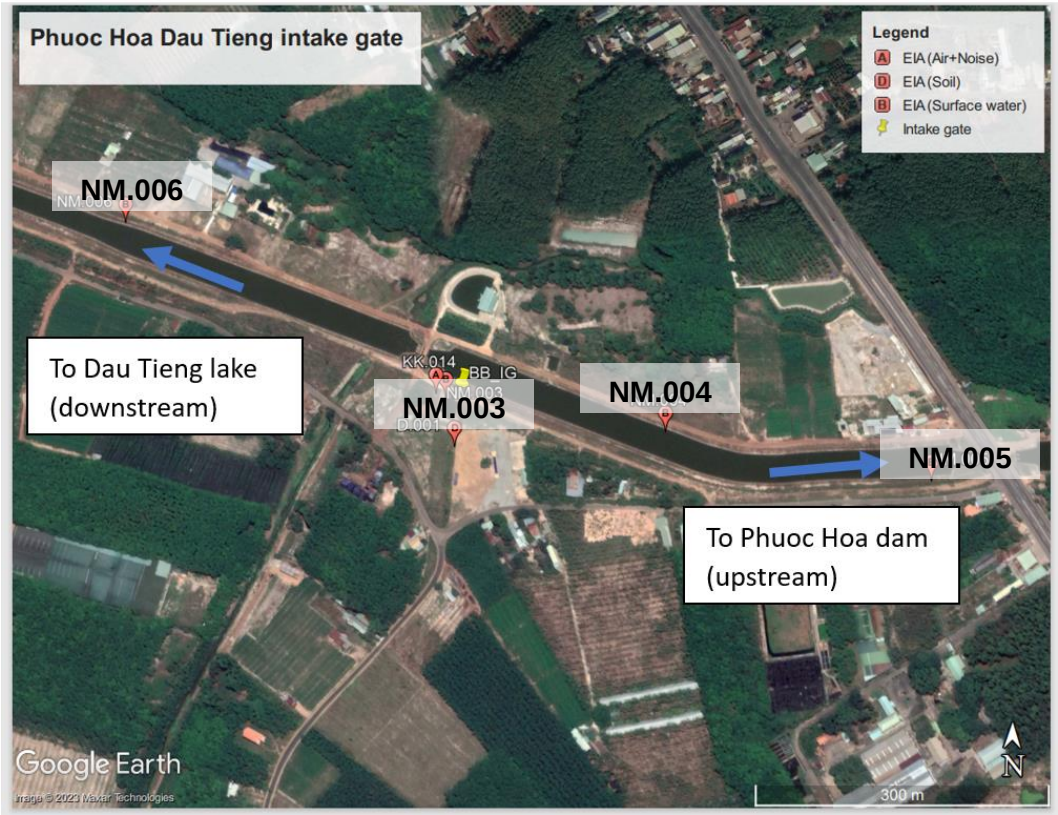


Figure 5-3: Sampling locations (Intake Gate)

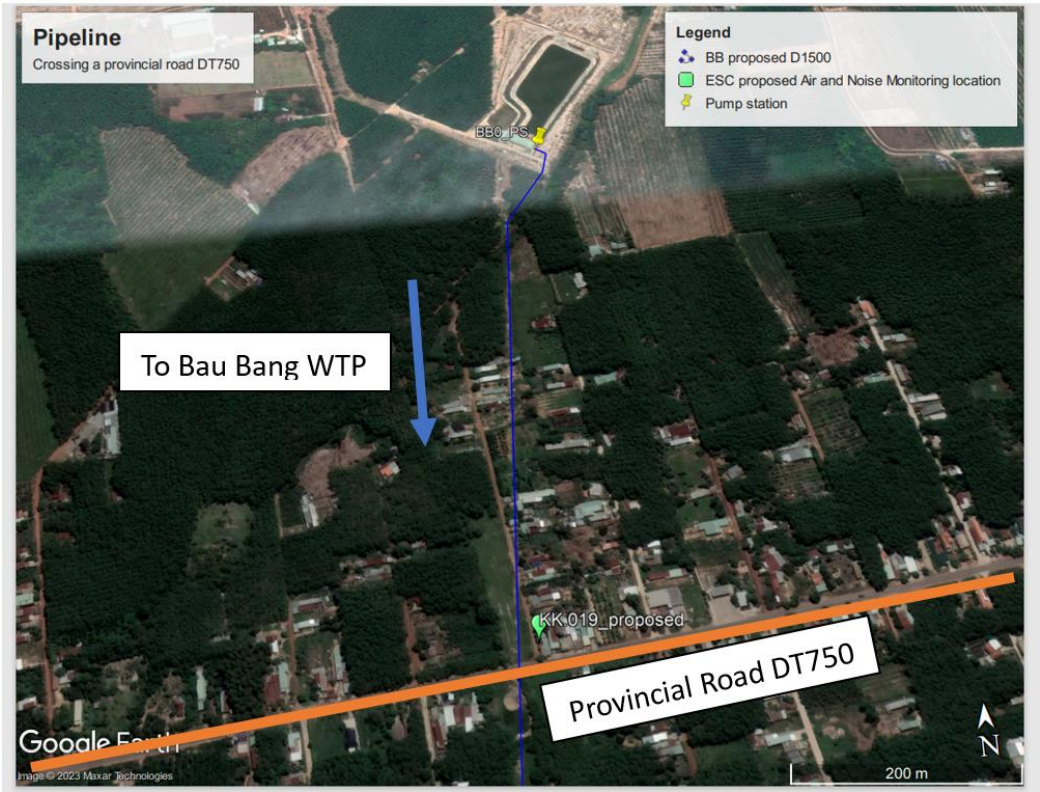


Figure 5-4: Sampling locations (Pipeline segment 1 and Pump station)

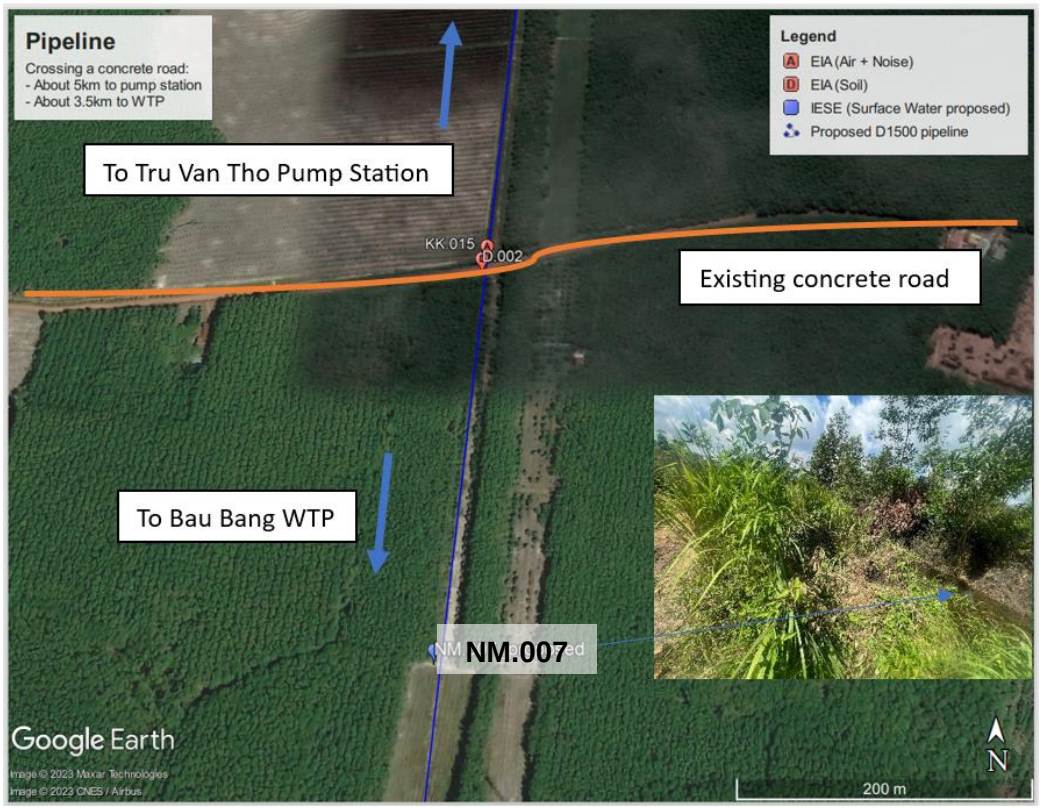


Figure 5-5: Sampling locations (Pipeline segment 2)

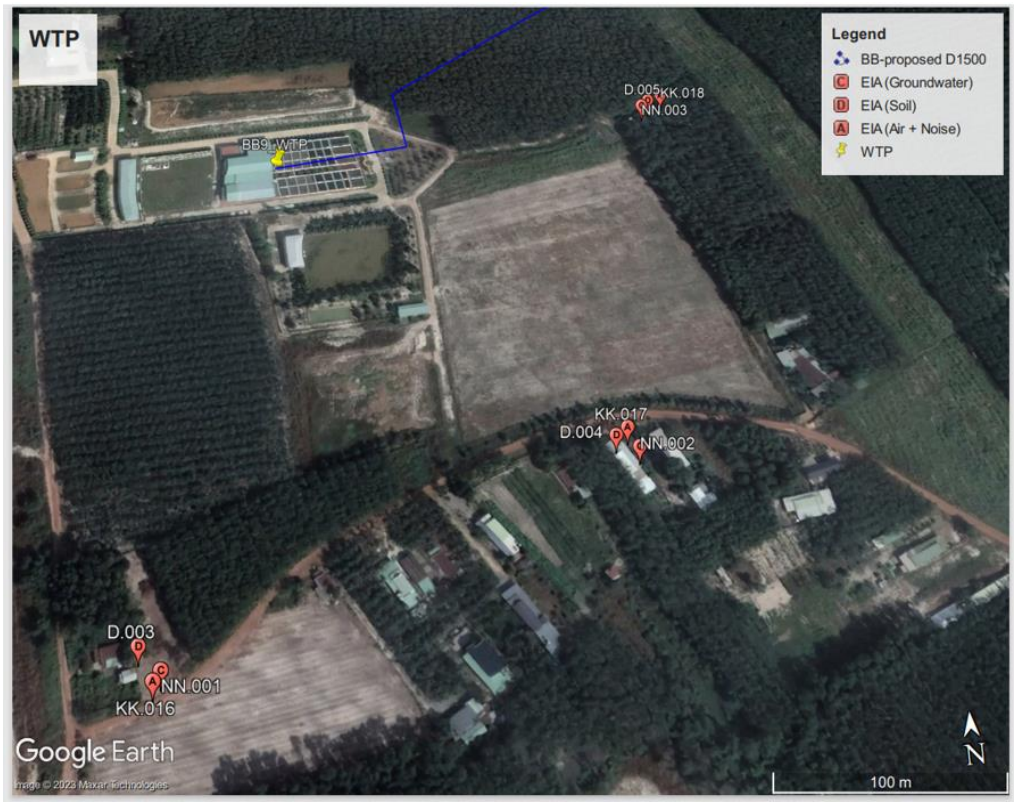


Figure 5-6: Sampling locations (Pipeline segment 3 and WTP)

Table 5-4: Surface water sampling results

No.	Parameter	Unit	Results					QCVN 08: 2023/BTNMT class A categorization[12]	QCVN 08: 2023/BTNMT class B categorization [13]	QCVN 08: 2023/BTNMT class C categorization [14]	QCVN 08: 2023/BTNMT class D categorization [15]
			NM.003	NM.004	NM.005	NM.006	NM.007				
1	pH	-	5.40	5.76	5.98	6.03	4.50	6.5-8.5	6.0-8.5	6.0-8.5	< 6.0 or > 8.5
2	COD	mg/l	10	13	13	16	12	10	15	20	> 20
3	BOD_5	mg/l	4.2	5.6	6.0	6.7	6.9	4	6	10	> 10
4	DO	mg/l	5.36	5.92	5.57	5.63	15.5[16]	> 6.0	> 5.0	> 4.0	< 4.0
5	TSS	mg/l	42	32	38	40	51	25	100	> 100	> 100
6	Total coliform	MPN/100ml	1,700	2,100	1,200	1,100	1,550	1,500	5000	7,500	> 7,500
7	Nitrate	mg/l	0.63	0.70	0.75	0.72	0.53	10	10	10	10
8	Phosphate	mg/l	ND (0.009)	ND (0.009)	ND (0.009)	ND (0.009)	ND (0.009)	0.3	0.3	0.3	0.3
9	Ammonium	mg/l	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.3	0.3	0.3	0.3
10	Arsenic	mg/l	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	0.01	0.01	0.01	0.01

[12] Class A: Good quality, with high DO, can be used in treatment for domestic water supply– to be applied for NM.003, NM.004, NM.005 and NM.006 samples
[13] Class B: Average quality (can be used in industrial production and agricultural use after suitable treatment) – to be applied for NM.007 sample
[14] Class C: Low quality (can be used in industrial production use after suitable treatment)
[15] Class D: Very low quality (waterway transportation only)
[16] While others locations showed a typical dissolved oxygen (DO) level in the range of 5-6 mg/L, which is indicative of a healthy aquatic ecosystem, the reading of 15.7 mg/L at NM.007 may indicate a highly saturated DO condition, or more likely that there might be a potential for errors or uncertainties in the measurement. Additional verification or quality control checks may be advisable to ensure the accuracy of the results.

No.	Parameter	Unit	Results					QCVN 08: 2023/BTNMT class A categorization[12]	QCVN 08: 2023/BTNMT class B categorization [13]	QCVN 08: 2023/BTNMT class C categorization [14]	QCVN 08: 2023/BTNMT class D categorization [15]
			NM.003	NM.004	NM.005	NM.006	NM.007				
11	Lead	mg/l	0.004	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	0.02	0.02	0.02	0.02
12	Mercury	mg/l	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	0.001	0.001	0.001	0.001
13	Iron	mg/l	**2.48**	**2.05**	**2.25**	**1.98**	**2.68**	0.5	0.5	0.5	0.5
14	Nitrite	mg/l	ND (0.011)	ND (0.011)	ND (0.011)	ND (0.011)	ND (0.011)	0.05	0.05	0.05	0.05
15	Total oil and grease	mg/l	3.2	0.5	0.5	2.6	3.6	5.0	5.0	5.0	5.0

*Notes: ND = Not detected (limit of the detection)

Results exceeding QCVN 08:2023/BTNMT is **Bolded in Red**

5.7.2 Groundwater Quality

In accordance with QCVN 09:2023/BTNMT – National Technical Regulation on Underground Water Quality, three household's well near the Bau Bang WTP was selected to determine the baseline groundwater quality of the project area. Baseline groundwater quality sampling was carried out on 12 October 2023. The sampling locations are shown in Table 5-5 below.

Laboratory results in Table 5-6 showed that all measured parameters (i.e. total hardness, TDS, heavy metals, E-Coli, and Coliform) were within the permissible limits prescribed in QCVN 09:2023/BTNMT National Technical Regulation on groundwater quality. The value of pH was lower than the acceptable range, however the groundwater quality in the project area is still defined as satisfactory.

Table 5-5: Groundwater sampling locations

Sample No.	Sampling date	Location	WGS84 coordinate	
			Lattitude	Longitude
NN.001	12 October 2023	Surrounding WTP (Le Thi Hien household)	11.289437	106.602246
NN.002	12 October 2023	Surrounding WTP (Tran Thi Xe household)	11.290218	106.604336
NN.003	12 October 2023	Surrounding WTP (Pham Thai Thanh household)	11.292187	106.604681

Table 5-6: Groundwater sampling results

No.	Parameter	Unit	Results			QCVN 09:2023/BTNMT
			NN.001	NN.002	NN.003	
1	pH	-	4.48	3.76	3.75	5.8 – 8.5
2	Total hardness	mg/l	ND (5.00)	ND (5.00)	ND (5.00)	500
3	TDS	mg/l	31	20	14	1,500
4	Arsenic	mg/l	ND (0.002)	ND (0.002)	ND (0.002)	0.05
5	Manganese	mg/l	ND (0.03)	ND (0.03)	ND (0.03)	0.5
6	Iron	mg/l	0.57	0.54	0.62	5
7	Lead	mg/l	ND (0.001)	ND (0.001)	ND (0.001)	0.01
8	Ammonium	mg/l	ND (0.009)	ND (0.009)	ND (0.009)	1
9	Nitrate	mg/l	0.23	0.64	0.25	15
10	Nitrite	mg/l	ND (0.01)	ND (0.01)	ND (0.01)	1

No.	Parameter	Unit	Results			QCVN 09:2023/BTNMT
			NN.001	NN.002	NN.003	
11	Sunfate	mg/l	ND (0.5)	ND (0.5)	ND (0.5)	400
12	Coliform	CFU/100ml	ND (1)	ND (1)	ND (1)	3
13	E.Coli	CFU/100ml	ND (1)	ND (1)	ND (1)	ND

*Notes: ND = Not detected (limit of the detection)

5.8 Noise

Noise monitoring was conducted at one location – KK.019 (see Table 5-7) for 48 consecutive hours from 23 to 24 November 2023 in order to obtain the baseline ambient noise levels. Five other locations (KK.014 – KK.018), 1-hour Leq was measured in October 2023, and the results were compared against the local Vietnamese regulation QCVN 26:2010/BTNMT – National Technical Regulation on Noise as well as the IFC's EHS Guidelines for Noise Management (1-hour Leq).

The results showed that pre-existing baseline ambient noise levels were relatively low at the time when the measurements were obtained. All of the results were recorded lower than the limit in QCVN 26:2010/BTNMT (for both daytime and nighttime), however comparing to the IFC EHS guideline thresholds, the noise levels at three household locations were slightly higher than the limits (55 dBA for daytime and 45 dBA for nighttime, respectively). Potential reasons for these exceedances could be noise from strong winds, pets and farm animals, and sometimes with operation of machines.

Table 5-7: Noise sampling locations

Sample No.	Sampling date	Location	Receptor	WGS84 coordinate	
				Lattitude	Longitude
KK.014	12 October 2023	Intake gate (at point K15+710 Phuoc Hoa – Dau Tieng canal)	Industrial; commercial	11.358506	106.626132
KK.015	12 October 2023	8.0 km pipeline (crossing a concrete road)		11.304374	106.617028
KK.016	12 October 2023	Surrounding WTP (Le Thi Hien household)	Residential; institutional; educational	11.289392	106.602218
KK.017	12 October 2023	Surrounding WTP (Tran Thi Xe household)		11.290308	106.604309
KK.018	12 October 2023	Surrounding WTP (Pham Thai Thanh household)		11.292241	106.604791
KK.019	23 and 24 November 2023	8.0 km pipeline (crossing Provincal road DT750)		11.301256	106,620458

Table 5-8: Noise sampling results

Sample No.	Result (dBA) 1-hour Leq (dBA)		QCVN 26:2010/BTNMT 1-hour Leq (dBA)		IFC EHS Guidelines 2007 1-hour Leq (dBA)	
	06:00 – 21:00	21:00 – 06:00	06:00 – 21:00	21:00 – 06:00	07:00 – 22:00	22:00 – 07:00
KK.014 (Day 1)	56.9	48.1	70	55	70	70
KK.014 (Day 2)	58.4	49.0	70	55	70	70
KK.015 (Day 1)	57.9	49.4	70	55	70	70
KK.015 (Day 2)	56.4	51.1	70	55	70	70
KK.016 (Day 1)	58.1	49.9	70	55	55	45
KK.016 (Day 2)	57.8	49.1	70	55	55	45
KK.017 (Day 1)	56.1	51.1	70	55	55	45
KK.017 (Day 2)	57.3	49.0	70	55	55	45
KK.018 (Day 1)	58.5	49.2	70	55	55	45
KK.018 (Day 2)	55.5	49.9	70	55	55	45
KK.019 (Day 1)	57.1	48.3	70	55	55	45
KK.019 (Day 2)	58.0	48.8	70	55	55	45

5.9 Air Quality

The air quality baseline condition was evaluated in October and November 2023 for the local EIA at five locations (KK.014 – KK.018). At each sampling point, measurements were taken for seven monitoring parameters including Total Suspended Particulate (TSP), Carbon Monoxide (CO), Sulphur Dioxide (SO2), Nitrogen Dioxide (NO2), Ozone (O3), Particulate Matter 10 (PM10) and Particulate Matter (PM2.5). This ambient air quality monitoring was conducted in accordance with the National Technical Regulations on Ambient Air Quality (QCVN 05:2023/BTNMT) developed by the Vietnam Environmental Administration, Department of Science and Technology, Department of Legal Affairs alongside Circular No. 01/2023/TT-BTNMT dated on 13 March 2023, which was issued by the Ministry of Natural Resources and Environment. Detailed methods of measuring specific parameters are described below:

- Particulate matter 10 (PM10) and particulate matter 2.5 (PM2.5) were monitored over 24- hour periods with a filter rate of 5 L/min; and
- Total suspended Particles (TSP), Sulphur Dioxide (SO2), Nitrogen Dioxide (NO2) and Carbon Monoxide (CO) were monitored over 1-hour periods with an air flow rate of 1000 L/min for TSP, 0.5 L/min for NO2 and SO2, and 0.05 L/min for CO.

An additional baseline air quality survey was conducted in December 2023 (KK.019) to comply with the IFC Standard to support the air quality impact assessment. The monitoring methodology included passive diffusion tubes for monitoring of NO2, SO2, CO and O3. This approach was taken to align with the IFC General EHS Guidelines 2007. Locations and results of air quality monitoring points are shown in Table 5-9 and Table 5-10, respectively.

The concentration of all air pollutants measured during the monitoring surveys were within the thresholds prescribed in the QCVN 05:2013/BTNMT and IFC General EHS Guidelines 2007. Therefore, the ambient air quality in the Project area and its vicinity has been evaluated in good condition at the time of developing the EIA report.

Table 5-9: Air quality sampling locations

Sample No.	Sampling date	Location	WGS84 coordinate	
			Lattitude	Longitude
KK.014	12 October 2023	Intake gate (at point K15+710 Phuoc Hoa – Dau Tieng canal)	11.358506	106.626132
KK.015	12 October 2023	8.0 km pipeline (crossing a concrete road)	11.304374	106.617028
KK.016	12 October 2023	Surrounding WTP (Le Thi Hien household)	11.289392	106.602218
KK.017	12 October 2023	Surrounding WTP (Tran Thi Xe household)	11.290308	106.604309
KK.018	12 October 2023	Surrounding WTP (Pham Thai Thanh household)	11.292241	106.604791
KK.019	23 December 2023	8.0 km pipeline (crossing Provincal road DT750)	11.301256	106.620458

Table 5-10: Air quality sampling results

No.	Parameter	Duration	Unit	Results						QCVN 05: 2023/BTNMT	IFC General EHS Guidelines 2007
				KK.014	KK.015	KK.016	KK.017	KK.018	KK.019		
1	TSP	1-hour	µg/m^3	185	209	184	202	191	188	300	-
2	TSP	24-hour	µg/m^3	116	121	134	135	144	140	200	-
3	NO_2	1-hour	µg/m^3	40	42	49	43	47	50	200	200
4	NO_2	24-hour	µg/m^3	44	46	47	44	45	38	100	-
5	SO_2	1-hour	µg/m^3	32	25	25	27	25	24	350	-
6	SO_2	24-hour	µg/m^3	15	13	20	14	20	20	125	20
7	CO	1-hour	µg/m^3	5,982	6,290	5,369	5,460	6,451	6,437	30,000	-
8	CO	8-hour	µg/m^3	3,622	4,505	4,088	4,131	4,581	4,572	10,000	-
9	O_3	1-hour	µg/m^3	33	29	30	33	31	29	200	-
10	O_3	8-hour	µg/m^3	20	19	21	22	22	20	120	100
11	PM10	24-hour	µg/m^3	46	47	46	48	47	48	100	50
12	PM2.5	24-hour	µg/m^3	16	14	11	11	9	12	50	25

*Notes: - = Not Applicable

5.10 Soil

Sampling of soil baseline data (i.e., Pb, Zn, As, and Cd) was carried out at 3 sampling locations at the area surrounding Bau Bang WTP (Table 5-11). All measured soil quality results were much lower than the permissible limits prescribed in QCVN 03:2023/BTNMT National Technical Regulation on Soil Quality, which is generally accepted by WBG EHS Guidelines. In addition, as observed during the scoping site visit, the terrestrial soil quality has no signs of pollution.

Table 5-11: Soil sampling locations

Sample No.	Sampling date	Location	WGS84 coordinate	
			Lattitude	Longitude
D.001	12 October 2023	Intake gate (at point K15+710 Phuoc Hoa – Dau Tieng canal)	11.358000	106.626323
D.002	12 October 2023	8.0 km pipeline (crossing a concrete road)	11.304284	106.616991
D.003	12 October 2023	Surrounding WTP (Le Thi Hien household)	11.289437	106.602246
D.004	12 October 2023	Surrounding WTP (Tran Thi Xe household)	11.290218	106.604336
D.005	12 October 2023	Surrounding WTP (Pham Thai Thanh household)	11.292187	106.604681

Table 5-12: Soil sampling results

No.	Parameter	Unit	Result					QCVN 03:2023/ BTNMT Class I
			D.001	D.002	D.003	D.004	D.005	
1	Arsenic (As)	mg/kg	0.72	ND (0.4)	ND (0.4)	0.41	0.43	25
2	Cadmium (Cd)	mg/kg	ND (0.049)	ND (0.049)	ND (0.049)	ND (0.049)	ND (0.049)	4
3	Chromium (Cr)	mg/kg	51.1	31.6	20.8	50.5	19.6	150
4	Lead (Pb)	mg/kg	2.88	1.18	0.62	1.77	0.57	200
5	Copper (Cu)	mg/kg	11.4	ND (3.74)	ND (3.74)	7.69	ND (3.74)	150
6	Zinc (Zn)	mg/kg	21.2	3.41	ND (1.70)	27.7	ND (1.70)	300

*Notes: ND = Not detected (limit of the detection)

5.11 Biodiversity

5.11.1 Protected Area

Based on the Integrated Biodiversity Assessment Tool (IBAT) Proximity Report for VIE TDM BAU BANG WTP (IBAT, 31 July 2023), no protected areas or Key Biodiversity Areas (KBA) are present within 20km from the Bau Bang project footprint. However, KBAs within 50km from the project area (intake point) include Cat Tien, Boi Loi, Dong Nai, Duong Minh Chau, and Nui Ba Den, whereas 2 KBAs, Vinh Cuu and Vinh Cuu Extension, of Dong Nai Natural Reserve lied within the 50km buffer zone. Location of the identified KBAs are shown in Figure 5-7.

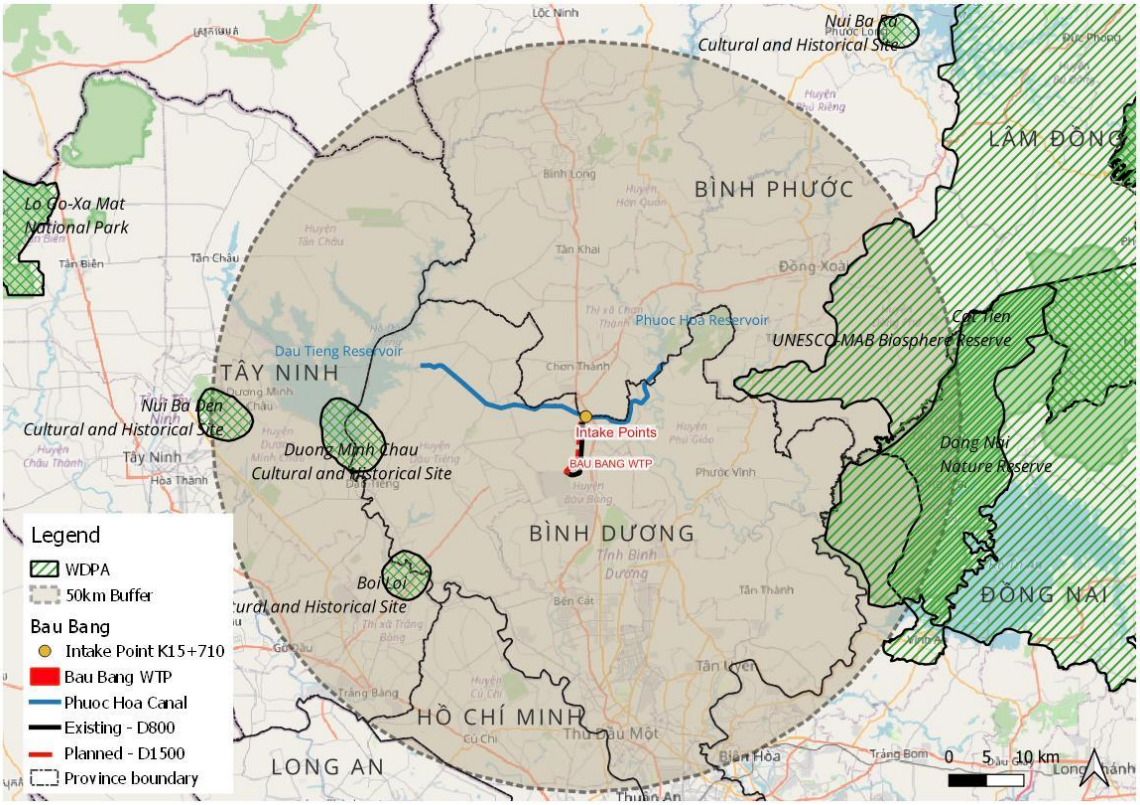


Figure 5-7: Project location and KBAs within 50km[17]

5.11.2 Terrestial Fauna and Flora

From the site observations, habitats in the vicinity of Bau Bang WTP and along the pipelines are generally rubber trees plantation, fruit trees plantation, and some crops such as cassava and other seasonal fruits, besides the scrubs and bushes.

[17] World database on Protected Area (WDPA): UNEP-WCMC and IUCN (2024), Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM) [Online], March 2024, Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net.

Figure 5-8: Habitat in the vincity of the pipeline segment 1 (scubs, bushes and banana trees)

Figure 5-9: Habitat in the vincity of the pipeline segment 2 (cassava and watermelon fields)

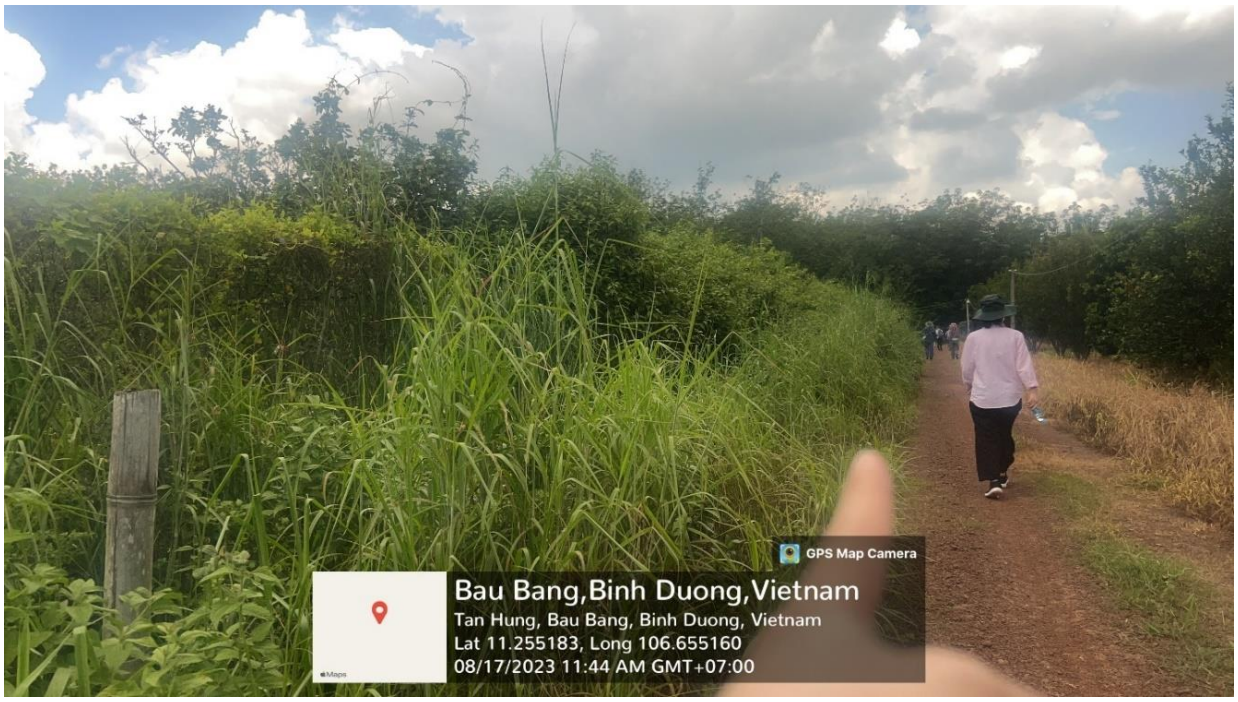


Figure 5-10: Habitat in the vincity of the pipeline segment 3 (rubber forest, fruits and scubs/ bushes)

5.11.3 Aquatic life

To prepare for the regulatory EIA[18], baseline of aquatic life at the Project site has been sampled and analyzed. Four representative locations, including the intake gate, and distance from 500-1000 m upstream and downstream from the intake (refer to Table 5-13Table 5-13), were selected for aquatic life sampling and laboratory analysis on 30 Octorber 2023.

Appendix B provides qualitative and quantitative analysis of the results based on total number of species and total density (population/litter) of three planktonic communities, which are:

- zooplankton
- phytoplankton (plantplankton)
- benthos (benthic macroinverebreates)

The laboratory analysis and assessment of the aquatic ecosystem, including both surface and bottom-dwelling flora and fauna, indicate that the water habitat in the intake area has a relatively low biodiversity value, in accordance with the general characteristics of the ecosystem in the region. No rare or endangered species have been identified.

[18] As of March 2023, a draft version of the regulatory Environmental Impact Assessment (EIA) has been submited to Binh Duong DONRE and pending for approval.

Table 5-13: Aquatic life sampling locations

Sample No.	Sampling date	Location	WGS84 coordinate	
			Lattitude	Longitude
AL1	12 October 2023	Intake gate (at point K15+710 Phuoc Hoa – Dau Tieng canal)	11.358470	106.626233
AL2	12 October 2023	500m upstream from intake gate	11.358183	106.628367
AL3	12 October 2023	1000m upstream from from intake gate	11.357769	106.630940
AL4	12 October 2023	500m downstream from intake gate	11.360125	106.622986

5.11.4 Critical Habitat Screening

Criteria ADB and IFC

ADB Safeguard Policy adopted IFC PS3 Guidelines, which include the need for a screening process, environmental assessment commensurate with risk, examination of alternatives, carrying out meaningful consultation with affected people to facilitate their informed participation, disClosure of environmental assessment, avoidance of critical habitats unless specific conditions are met, application of pollution and prevention control technologies.

In accordance with IFC PS 6, habitats are divided into modified habitats, natural habitats, and critical habitats. Critical Habitats (CH) are a subset of either modified or natural habitats supporting high biodiversity value, including (for ADB):

- Habitat of significant importance to critically endangered and/or endangered species (International Union for Conservation of Nature and Natural Resources (IUCN) Red List);
- Habitat of significant importance to endemic and/or restricted-range species;
- Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
- Highly threatened and/or unique ecosystems;
- Areas with unique assemblages of species or that are associated with key evolutionary processes;
- Areas that provide key ecosystem services and areas having biodiversity of significant social, economic, or cultural importance to local communities.

Since habitat destruction is recognized as a major threat to the maintenance of biodiversity and to assess likely significance of impacts, IFC PS 6 requires the following depending on habitat status:

- Modified Habitat: exercise care to minimize any conversion or degradation of such habitat, depending on scale of project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of operations.

- Natural Habitat: developer will not significantly convert or degrade such habitat unless no financial/technical feasible alternatives exist, or overall benefits outweigh cost (including those to biodiversity), and conversion or degradation is suitably mitigated. Mitigation must achieve no net loss of biodiversity where feasible; offset losses through creation of ecologically comparable area that is managed for biodiversity, compensation of direct users of biodiversity.
- Critical Habitat: in areas of CH, the Developer will not implement project activities unless there are no measurable adverse impacts on the ability of the critical habitat to support established populations of species described or on the functions of the critical habitat; no reduction in population of a recognized critically endangered or endangered species and lesser impacts mitigated as per natural habitats. The project must achieve net gains for the biodiversity value for which the Critical Habitat was designated.

JICA E&S considerations

Projects must not involve significant conversion or significant degradation of critical habitats or critical forests. Illegal logging of forests must be avoided. Project proponents need to obtain logging permits from regulatory agencies and are encouraged to obtain forest certifications for forestry projects, in order to ensure the prevention of illegal logging.

Habitat types in the project area

Majority of the land uses within and surrounding the project area are primarily for agriculture (i.e., fruit and rubber plantations, farmlands, etc.) and scrubs and bushes. Naturally, the vegetation in this area would be dry evergreen forest. On land, the project footprint can therefore be considered to be Modified Habitat.

Raw water inflows are sourced from Phuoc Hoa – Dau Tieng canal which is a man-made irrigation channel. The main area of project aquatic impacts can thus also be categorised as Modified Habitat.

CHA screening results

Based on desktop review, Bau Bang WTP project footprint, including the existing Bau Bang WTP and the existing pipeline alignments, as well as expansion of Bau Bang WTP and the proposed 8.0km pipeline do not reside within any protected areas or KBAs. These legally protected areas are only present beyond the 20km buffer according to the IBAT proximity report.

According to the IUCN Red List (IBAT, 31 July 2023), 86 threatened flora and fauna species potentially reside within a 50km buffer zone from the project area. The majority are mammals (MAMMALIA) make up the largest group with 24 species, followed by birds (AVES) with 20 species and reptiles (REPTILIA) with 17 species, and Magnoliopsida with 14 species. Among these species, 42 species are categorized as Vulnerable (VU), 17 as Critically Endangered (CE) and 26 as Endangered (EN). By biome, the species distribution is as follows: freshwater (29 species), terrestrial (79 species), marine (8 species). Majority of species (79) are experiencing a decreasing population trend. Only one species is reported to have a stable population (Zingiber collinsii - VU). A full list of the IUCN Red List species are provided in Appenix C.

However, these species are not expected in significant numbers in the project area. The habitat within and in the vicinity of the project site has been heavily altered by the conversion of natural landscapes to agricultural use and other continuous human activities.

It is noted that with the presence of Poropuntius deauratus (one of the EN fish triggering Vinh Cuu Extension KBA which are situtated within the Dong Nai Natural Reserved [19]) in the catchment that feeds into the Phuoc Hoa- Dau Tieng canal as shown in catchment analysis[20] (Figure 5-11). This fish species might still be present along the canal and might follow the intake facility to enter the reservoir at the pumping station. However, information on the distribution and abundance of this species is limited. In addition, the aquatic baseline surveys carried out fo the local EIA at the intake point indicated a low biodiversity value, with no rare or endangered species identified. On a precautionary basis, the overall project area is therefore considered to be Critical Habitat for Poropuntius deauratus.

Further details on impact assessment and mitigation measures will be provided in Section 6.6.4.

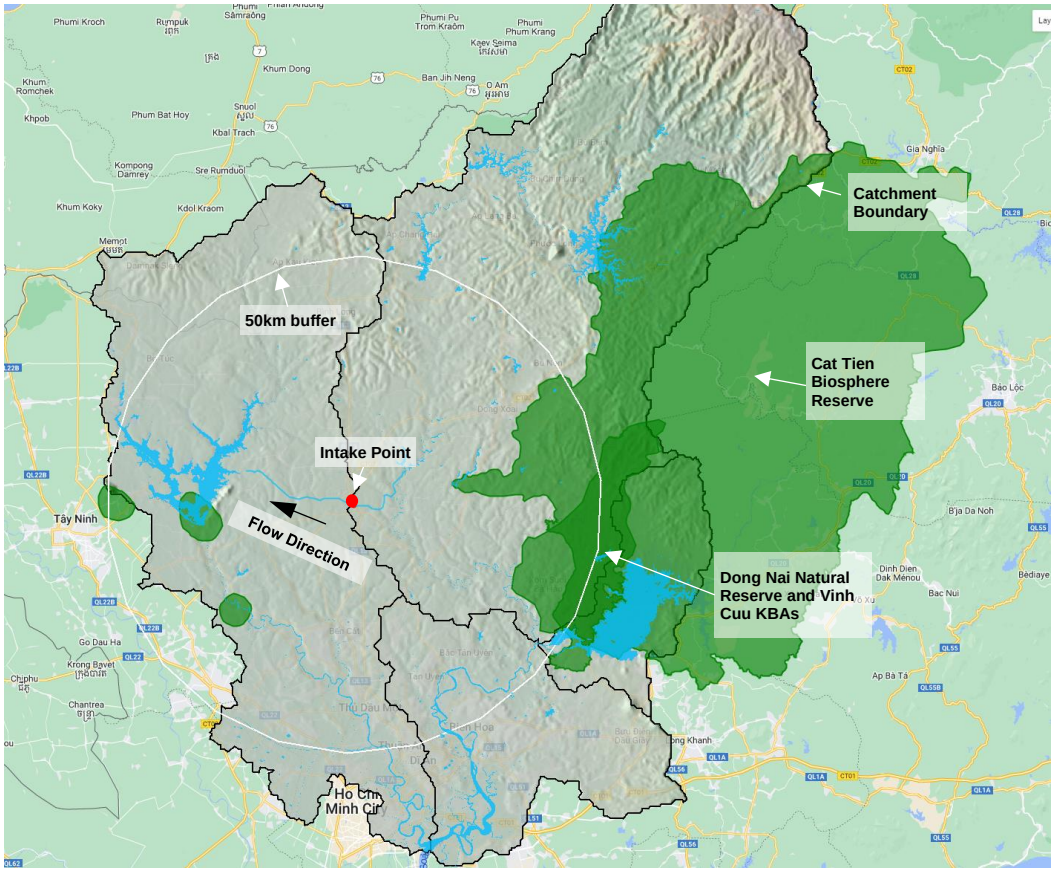


Figure 5-11: Catchment boundaries and KBAs within 50km buffer from the Project site

5.12 Physical and Cultural Resources

As observed during the site visits, no physical or cultural resources identified within the vicinity of the Bau Bang WTP compound and along the proposed 8.0km alignment.

[19] Dong Nai Natural Reserve (https://tapchimoitruong.vn/)

[20] Catchment boundaries: WWF HydroSHEDS Basins Level 7, available at http://www.hydrosheds.org/

5.13 Socio-Economic Baseline – Local Context

The Project is in Tru Van Tho commune and Lai Uyen commune-level town, Bau Bang district, Binh Duong province. Socio-economic profiles have been prepared for the Project area. Secondary data sources on Project conditions are population and employment, economy, and access to public services.

5.13.1 Binh Duong Province Overview

Binh Duong province is located in the Southeast region of Vietnam and occupies a natural area of 2,694.43 square kilometres (km2), covering four cities (Thu Dau Mot, Di An, Tan Uyen, and Thuan An), four districts (Bac Tan Uyen, Dau Tieng, Phu Giao, and Bau Bang), and one town (Ben Cat)[21] (see Figure 5-12). The province has a border with Binh Phuoc province to the North, Ho Chi Minh city to the South and the Southwest, Dong Nai province to the East, and Tay Ninh province to the West.

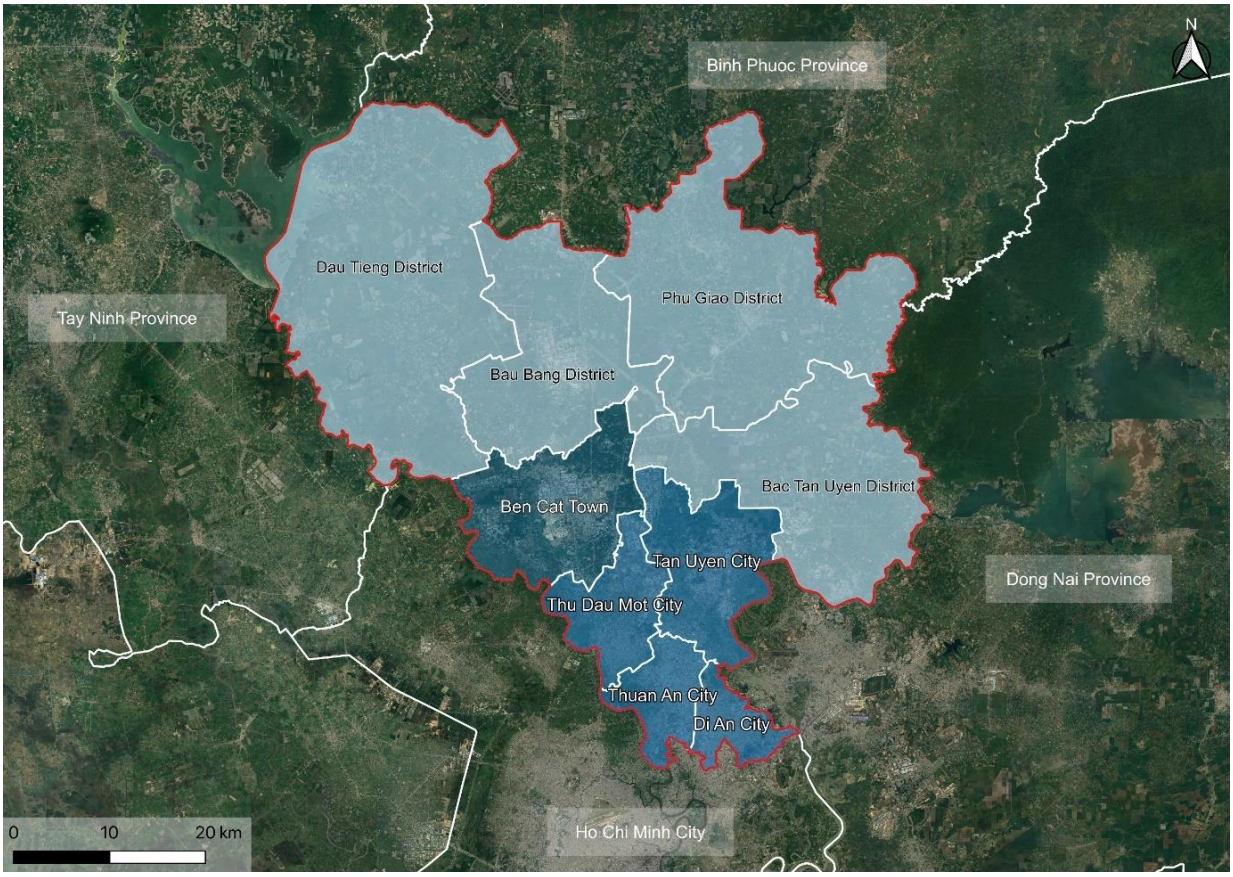


Figure 5-12: Locations of Binh Duong Province and Administrative Units

The population of Binh Duong province was 2,763.1 thousand people in 2022, with a population density of about 1,025 people/km2, the second highest figure in the Southeast region after Ho Chi Minh city. In 2022, Binh Duong province is one of the two provinces with the highest in-migration rate (26.4%)[22].

[21] Binh Duong Province Portal (n.d.)
[22] GSO (2023)

In 2022, the province's labour force aged 15 and over was 1,782,806 people, an increase of 4.2%, with 72,449 people compared to that in 2021, of which the male and female labour force accounted for 50.94% and 49.06%, respectively. Labor division was unevenly distributed between rural and urban areas, with 14.3% and 85.7%, respectively. The unemployment rate of the labour force in working age in 2022 was 1.31%, of which the rate of the urban area was 1.23% and the rate of the rural areas was 1.80%[23].

Binh Duong's GRDP in 2023 increased by 5.97%, with GRDP per capita of VND 172 million per year. The province's economic structure is industry - service - agriculture - product tax minus product subsidies with the corresponding proportion of 66.3% - 23.7% - 2.6% - 7.4%. The industry is identified as the province's key economic sector, with the highlight given to manufacturing[24]. Binh Duong has 29 industrial parks, with a total area of 12,600 hectares (ha) and an occupancy rate of 91%. The province plans to develop 15 more industrial parks, with a total area of 10,200 ha, which will meet the requirements of attracting and arranging investment projects. Currently, Binh Duong has 64,333 domestic enterprises with a total registered capital of VND 699,000 billion and 4,176 foreign-invested projects with a total registered capital of more than USD 40 billion[25.]

Binh Duong province's electricity is provided from the national grid with high voltage transmission lines and substations of 110kV, 220kV, and 500kV. Binh Duong province provides enough electricity for industrial zones and households' usage. All province households accessed electricity in 2022[26]. The province's commercial electricity output reached 15 billion KWh in 2023, a decrease of 3.1% compared to that in 2022[27] .

As of 2020, the domestic water supply system in the province has been provided according to the approved water supply plan, and the scope of clean water supply to the urban areas has been expanding. In 2022, the province's rate of population supplied with hygienic water reached 100%, the percentage of the urban population provided with clean water by a centralized water supply system was 72.3%, and the percentage of households using hygienic toilets was 99.91%[28].

In 2022, the province had 438 preschools, 159 primary schools, 81 lower secondary schools, 27 upper secondary schools, six primary and secondary schools, and 12 lower and upper secondary schools. Regarding healthcare, the number of medical examination and treatment facilities in the province was 141, including 28 hospitals, 19 regional polyclinics, and 91 health stations in communes, wards, and townships. All communes have health stations meeting national standards, with an average of two doctors and two nurses for each. The number of patient beds was 5,537 beds. The average number of patient beds managed by state medical facilities per ten thousand people was 19.7. The average number of doctors per ten thousand people was 7.51 people. Total number of medical and pharmaceutical staff was 10,287 people[29].

By early 2023, the rate of poor households in Binh Duong decreased to 1.54%, and the rate of near-poor households was 0.47%[30]. The total number of poor households was 5,971 out of the province's 387,342

[23] Binh Duong Statistics Office (2023)
[24] Binh Duong PPC (2023)
[25] Ban Mai (2023)
[26] GSO (2023)
[27] Binh Duong PPC (2023)
[28] Binh Duong Statistics Office (2023)
[29] Binh Duong Statistics Office (2023)
[30] Tran Khanh (2023)

households. The program strives to reduce the poverty rate by at least 0.3% each year, and by the end of 2025, the poverty rate in the province will be below 1%[31].

5.13.2 Bau Bang District Overview

Bau Bang district is in the North of Binh Duong province along National Road 13, about 35km from Thu Dau Mot city to the North and 70km from Ho Chi Minh city in the direction of National Road 13. The district has borders with Chon Thanh district (Binh Phuoc province) to the North, Ben Cat district-level town to the South, Phu Giao district to the East, and Dau Tieng district to the West[32].

The district's natural landmass is about 340.02km2, covering six communes (Tru Van Tho, Cay Truong II, Tan Hung, Long Nguyen, Hung Hoa, and Lai Hung) and one commune-level town (Lai Uyen)[33]. In 2022, the average population of Bau Bang district was 117,370, with a population density of 345 people/km2. Bau Bang recorded the highest population density among districts of Binh Duong province (including Dau Tieng, Phu Giao, and Bac Tan Uyen). Ethnic minorities were recorded from 111 households, with 266 people, including Khmer, Muong, Hoa, Thai, Tay, Tho, San Diu, Cham, Nung, Sa Rieng, and Sieng Tieng.

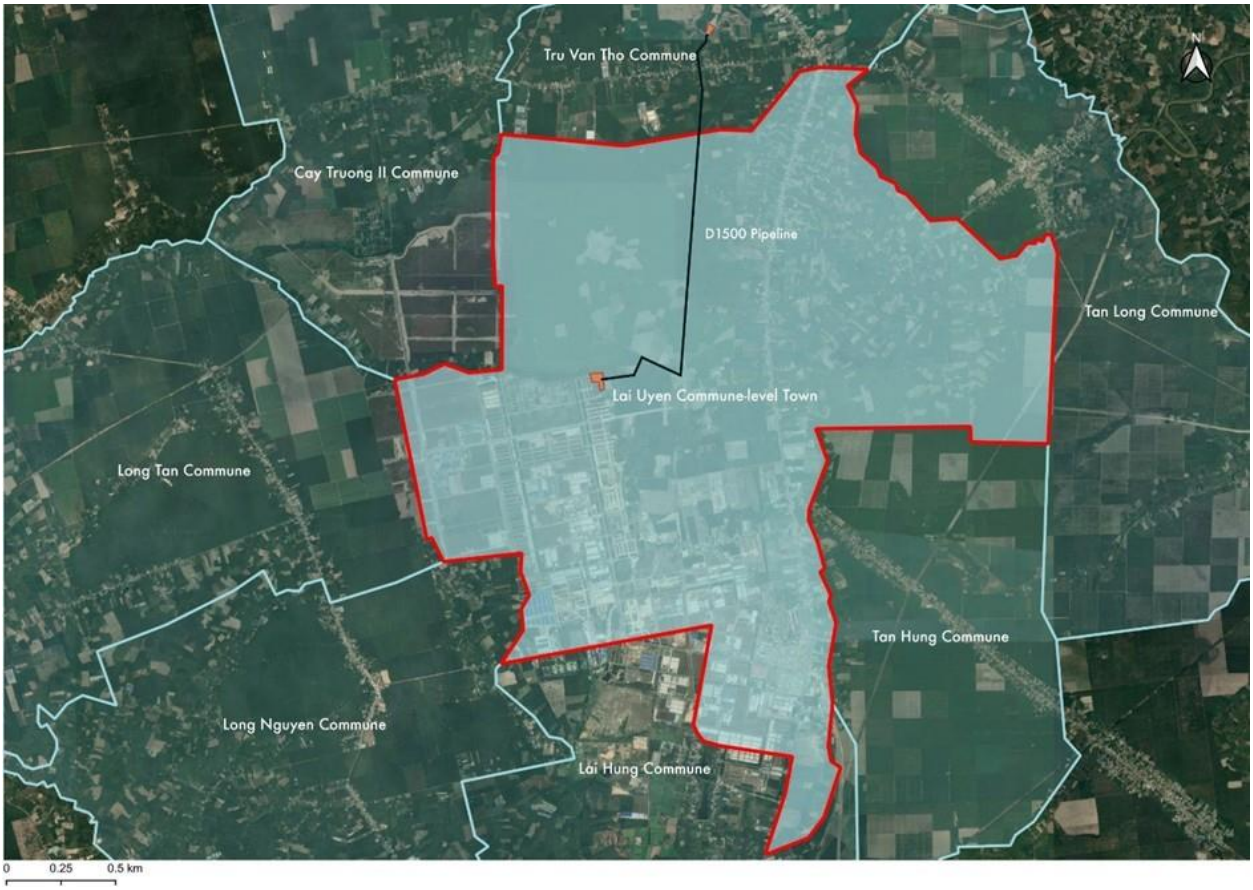


Figure 5-13: Locations of Bau Bang District and Administrative Units

The district's economic pillar is the industry sector. In 2022, the production value in industry - investment, trade - service, and agriculture was estimated at VND 29,264.6, VND 7,918.8, and VND 2,232.6,

[31] Doan Trang (2023)
[32] Bau Bang DPC Portal (2020)
[33] Bau Bang DPC Portal (2020)

respectively[34]. Aligned with the policy of promoting industrial development to the North of Binh Duong province, Bau Bang district is one of the province's top localities in terms of industrial growth. The district strives to become one of the province's northern industrial and urban centres. Bau Bang Urban - Industrial Park (IP) had an area of 3,200 ha, a significant increase from an initial area of 1,000 ha. The IP was invested and constructed synchronously by BECAMEX IDC Corporation with complete infrastructure, creating strong development. In addition, Tan Binh IP (352.5ha), Cay Truong IP (700ha), and Lai Hung IP (600ha) were newly developed in the district area, increasing the total area of additional industrial land for development to 1,687.38 ha[35].

Bau Bang District People's Committee (DPC) completed the master plan for the district's socio-economic development to 2025 and deployed the district planning. Accordingly, worker housing areas were constructed with over 932,792 m^2 and more than 31,080 rooms, meeting the housing needs of more than 93,240 people. The DPC developed Lai Uyen town into a class-V urban area, with the vision to develop it into a class-IV urban area and two class-V urban areas, including Lai Hung commune and Long Nguyen commune[36].

Transportation in Bau Bang is very convenient, with a complete road system, facilitating travel needs and goods circulation. Binh Duong Avenue (National Highway 13) is a backbone road with six lanes and 28m road surface. Roads in Bau Bang Industrial Park have been completely invested. Other routes, such as provincial roads (DT750, DT749a, DT741b, and DT749c) and district roads, have been asphalted. In the future, additional routes, including Ho Chi Minh Road (passing North of the district), My Phuoc - Tan Van Road extending to Bau Bang Industrial Park - Urban Area and connecting Ho Chi Minh Street, and the metro line connecting from Binh Duong new city centre to Bau Bang will be invested and developed.

The district's commercial electricity output stably met the local demands in living and production. The consumed output was estimated at 944.88 million KWh. The district's rate of households accessing electricity reached 99.99% in 2022. The rate of households using hygienic water in rural areas reached 100%. The rate of households using clean water in urban areas reached 65.1% in 2022[37].

The district had 34 schools from kindergarten to upper secondary levels, including 29 public schools and five private schools. Notably, 89.7% of public schools in the district were recognised as meeting national standards[38]. Regarding healthcare, Bau Bang district had nine medical establishments, including one hospital, one regional polyclinic, and seven medical service units in precincts, offices, and enterprises, with 70 patient beds and 261 medical and pharmaceutical staff. The rate of communes having doctors and midwives was 100%. All communes met national health standards[39]. In 2022, the rate of population participating in insurance programs was estimated at 92.4%[40] .

[34] Bau Bang DPC (2022)
[35] Phuong Le & Ha Khanh (2022)
[36] Phuong Le & Ha Khanh (2022)
[37] Bau Bang DPC (2022)
[38] Bau Bang DPC (2022)
[39] Bau Bang Statistics Office (2023)
[40] Bau Bang DPC (2022)

By 2023, Bau Bang district had 169 poor households, accounting for 0.79% (139 poor households under the poverty reduction target, accounting for 0.65% and 30 poor households under social protection policies, accounting for 0.14%) and 70 near-poor households, accounting for 0.33%[41].

5.13.3 Lai Uyen Commune-level Town Overview

Lai Uyen town is Bau Bang district's commune-level administrative unit, established in 2018 based on the area and population of the initial Lai Uyen commune according to Resolution No.535/NQ-UBTVQH14 dated 11 July 2018 by the National Assembly. The town's total landmass was 88.36km^2, covering eight residential areas (Bau Bang, Bau Hot, Bau Long, Ben Lon, Cay San, Dong Cheo, Dong So, and Xa Mach). The town's population was 39,688 in 2021[42], reaching a population density of 449 people/km^2.

Lai Uyen town is in the centre of the Bau Bang district. The town borders Tru Van Tho and Cay Truong II communes to the north, Long Nguyen and Tan Hung communes to the south, Long Tan (Dau Tieng district) to the west, and Tan Long commune (Phu Giao district) and Tan Hung commune to the east.

Lai Uyen commune is the industrial centre of Bau Bang district, with the role of promoting socio-economic development in neighbouring communes in Bau Bang, Dau Tieng, and Phu Giao districts through the socio-economic exchange activities.

Implementing Decision No. 893/QD-TTg dated 11 June 2014 by the Prime Minister on adjusting the master plan for socio-economic development in Binh Duong province until 2020, supplementing the planning until 2025, Binh Duong Provincial People's Committee (PPC) issued Decision No. 1369/QD-UBND dated 31 May 2017 on approving the general planning project of Lai Uyen urban area until 2030. The PPC simultaneously oriented Lai Uyen urban area to become the centre of trade, services, and agricultural goods in the northern region of Binh Duong province. Accordingly, the town's economic structure shifted positively towards increasing the proportion of trade - service and industry - construction sectors, while reducing the proportion of agriculture sector. In 2018, 114 companies and enterprises with domestic and foreign investment capital were registered to operate in the town, contributing large budget resources to the locality, creating jobs for local workers, and attracting workers from other localities. In addition to the industry, the town's trade and service sector was also strongly developed in 2018, with 1,291 establishments registered to operate and two large markets (Lai Uyen and Bau Bang markets)[43].

5.13.4 Tru Van Tho Commune Overview

Tru Van Tho commune is located 13km from Bau Bang center to the north. The commune borders Thanh Tam commune (Chon Thanh district, Binh Phuoc province) to the north, Lai Uyen town to the south, Cay Truong II commune to the west, and Tan Long commune (Phu Giao district) to the east. The commune's total landmass was 27.8km2, covering four hamlet (Hamlet 1, Hamlet 2, Hamlet 3, and Hamlet 4).

Tru Van Tho commune's population was 13,119 in 2020, of which Kinh ethnicity occupied the largest proportion of 98.9%, and the insignificant remaining was of minority ethnic groups. The average income per capita of Tru Van Tho reached VND 61 million a year in 202044.

[41] Hong Phuong (2023)
[42] Binh Duong Province's Department of Health (2021)
[43] Vietnam Government (2018)
[44] Tru Van Tho Commune Portal (2020)

According to the head of Tru Van Tho Commune Farmers' Union, cultivation and husbandry contributed the highest proportion to the commune's economic structure. There were 42 husbandry farms, one transportation cooperative, one hygiene vegetable cultivation cooperative, one guava cultivation cooperative, and two cooperatives combining cow raising and fruit tree cultivation in Tru Van Tho commune in 2023. Local authorities focused on restructuring crop and livestock types, encouraging local people to choose appropriate agricultural models for high profit. Specifically, local authorities encouraged households practicing husbandry to follow VAC models and commit to using biogas tanks to ensure livestock development associated with environmental protection. The local authorities also coordinated with consulting agencies to instruct biosafety farming and ensure environmental hygiene.

Thanks to the replication of effective livestock and crop economic models, the socio-economic situation of Tru Van Tho commune has developed steadily, and the number of poor households decreased to 0.61% in 2022. The commune focuses on building a mechanism to support the consumption of local agricultural products, which facilitates local people to invest in production and improve the efficiency of economic models, especially a model of growing fruit trees[45].

5.13.5 Project Affected Villages

The affected villages (hamlets or residential groups) are identified in the table below:

Table 5-14: Project affected villages

Components	Commune/Commune-level Town	Number of affected villages	Name of affected villages
Pump station	Tru Van Tho	1	Hamlet 2
Segment 1 of D1500 pipeline	Tru Van Tho	1	Hamlet 2
Segment 2 of D1500 pipeline	Lai Uyen	3	Bau Hot hamlet Bau Long hamlet Cay San hamlet
Segment 3 of D1500 pipeline	Lai Uyen	1	Cay San hamlet
WTP	Lai Uyen	1	Cay San hamlet

The socio-economic profiles of Hamlet 2 and Cay San residential area were collected based on the consultations with local authorities.

- Hamlet 2 in Tru Van Tho commune has around 758 households, including 450 households with permanent residency and 308 households with temporary residency. There are approximately 20 poor and difficult households and ten ethnic minority households, primarily the Muong ethnic

[45] Tien Hanh (2023)

group, who migrated from Ha Tay, Ha Giang, and Nghe An provinces. The residents are involved in various livelihoods for income, including agricultural production, company employment, and small businesses, showing a diversified economy beyond agriculture. There are no significant cultural or historical landmarks within the project area, but a provincial-level relic, Bot Cay Truong, located approximately 1km away from Hamlet 2's centre.

- Cay San residental area consists of 647 households with a population of 2,720. Additionally, there are 2,485 households with 3,170 temporary residents in the locality. There are 12 households classified as poor, and no ethnic minority groups are recorded. Main religions practiced are Protestantism and Buddhism. Local households primarily use bore water, and a piped water system is only available on the main route. The main livelihoods in the area are agricultural production (e.g., rubber planting), company employment in the Bau Bang IP, and small businesses. There is a gradual occupational shift from agricultural production to waged employment. No cultural heritage within the project area is identified. Lai Uyen town only has one provincial-level cultural site - Bau Bang victory monument, about 5km from Cay San hamlet.

5.14 Socio-Economic Baseline - Household Level Data Analysis

The socio-economic basline survey for household level data analysis had been conducted from 9th to 11th May 2024. ESC gathered information from 25 household's representatives at Tru Van Tho commune and Lai Uyen commune-level town. Primary data from households were analysed based on a list of questionaires related to:

- Demorgraphic
- Employment and livelihoods
- Income and expenditure
- Land, housing and assets
- Community health
- Vulnerability
- Local perception

5.14.1 Demorgraphic

Population

An interview was conducted with 25 households to collect the information of 108 people, composed of 11 households in Lai Uyen commune-level town (townlet) with 51 people and 14 households in Tru Van Tho commune with 57 people.

The gender ratio of the interviewed households is 100 males : 86.2 females (58 males versus 50 females). However, this rate is significantly different between Lai Uyen townlet and Tru Van Tho commune. The gender ratio of Lai Uyen townlet is 100 males : 111.8 females while those of Tru Van Tho commune is 100 males : 67.7 females. This shows the diversity of population characteristics of the survey area and that the gender rate is different for the two communes despite being are adjacent to each other.

Table 5-15: Summaries of respondents by surveyed area and gender

No.	Item	All surveyed areas	Lai Uyen	Tru Van Tho
1	Total of households	25	11	14
2	Total of household members	108	51	57
3	Male	58	24	34
4	Female	50	27	23

Source: ESC's survey conducted in May 2024

Household Size

The average household size is 4.36 people per household. This number in Lai Uyen townlet and Tru Van Tho commune is 4.64 and 4.14 respectively. The highest number of members in household is nine people (Lai Uyen) and the lowest is two persons (Tru Van Tho). The details are shown below:

Table 5-16: Household size by commune

No.	Household size	All surveyed areas (N=25)	Lai Uyen (N=11)	Tru Van Tho (N=14)
1	Average household size (people)	4.36	4.64	4.14
2	Maximum household size (people)	9	9	6
3	Minimum household size (people)	2	3	2

Source: ESC's survey conducted in May 2024

Ethnicity

There are only one ethnic group in the surveyed area which is Kinh ethnic (accounting for 100% of population). It is noted that two household heads, as identified by the village head and the Project representative, are of Muong ethnicity group. However, during interviews, they self-identified themselves as Kinh people. They got married to Kinh spouses and have settled their lives in this area for a long time (since 1980).

Religion

Most of the surveyed people (102 people equivalent to 94.5%) identified themselves as non-religious. There are five people (4.6%) including one person in Lai Uyen and four people in Tru Van Tho that are Buddhist adherents and one people (0.9%) in Lai Uyen that practices Catholicism. However, there is no religious facilities in the study areas and most of religious activities are spontaneous, family-sized and do not affect the surrounding community.

Age Groups

Most people (75 people out of 108 people, accounting for 69.4%) in the surveyed households are between 15 to 60 years old. The largest percentage is represented by individuals between 36 to 45 years comprising of 28 people (25.9%). Another 28.7% of the surveyed population (31 people) are below 15 years old, and the elderly group (people above 60 years old) accounted for 12% of the surveyed population (13 people).

Table 5-17: Age groups by commune

No.	Age groups	All surveyed areas (N=108)		Lai Uyen (N=51)		Tru Van Tho (N=57)	
		N	%	N	%	N	%
1	Under 6 years old	8	7.41	2	3.92	6	10.53
2	From 6 to 15 years old	23	21.30	15	29.41	8	14.04
3	From 16 to 18 years old	6	5.56	3	5.88	3	5.26
4	From 19 to 25 years old	5	4.63	4	7.84	1	1.75
5	From 26 to 35 years old	9	8.33	2	3.92	7	12.28
6	From 36 to 45 years old	28	25.93	14	27.45	14	24.56
7	From 46 to 60 years old	16	14.81	6	11.76	10	17.54
8	Over 60 years old	13	12.04	5	9.80	8	14.04
		108	100.00	51	100.00	57	100.00

Source: ESC's survey conducted in May 2024

Marital Status

Out of the 108 surveyed people, 59 people are married (54.6%), 46 people are single (42.6%) including 9 individuals (8.3%) are in marriage age[46] , and three female were widowed (2.8%). Marriage at a young age often occurred among older people of the previous generations when legal awareness was low. However, this situation is almost non-existent now.

Educational Attainment

Education levels were considered for household members who were six years old and older at the time of the survey (May 2024). Eight surveyed people are identified as under school age. Hence, education attainment analysis was based on the collected data of 100 surveyed people.

Only one surveyed person 8 years old (1%) is illiterate, 42 people (42%) have acquired or are attending primary education, 27 people (27%) completed secondary school and 26 people (26%) completed high school level. Eight people (8%) have attended the college-university level, of which five people are university graduates and three people are still pursuing their study in various universities.

5.14.2 Employment and livelihoods

Labour Force

According to the survey data, 64 people (59.3%) out of 108 surveyed population are of working age which is defined as between 15 and 55 years old for females and between 15 and 60 years old for males47, 30 people (27.8%) are under the working age and 14 people (12.9%) are over the working age. Those over the working age only actively participate in the family's economic activities if they are healthy enough. In rural areas of Vietnam, it is quite common for the family's economic involvement not to be solely determined by age.

[46] According to Vietnam's Marial Act, the marriage age population consisits of those aged from 18 for females and 20 for males

[47] According to the Vietnam's Labour Code, the working-age population consists of those aged 15 and 55 years old for females and 15-60 for males, considered able and likely to work.

Among the 64 people within the working age, 47 people (73.4% of the surveyed working age people or 43.5% of the surveyed population) are employed. The remaining 17 people (26.6% of the surveyed working age people or 15.7% of the surveyed population) are unemployed (three people), students (10 people), and not employed (four people). These unemployed people are defined as housewife, or in early retirement and receiving financial support from their children. Five people over working age but still generate incomes for their family, therefore totally there are 56 individuals do not participate in income-generating activities within the surveyed households.

Table 5-18: Labour force by commune

No.	Age groups	All surveyed area (N=108)		Lai Uyen (N=51)		Tru Van Tho (N=57)	
		N	%	N	%	N	%
1	Under working age	30	27.78	16	31.37	14	24.56
2	Over working age	14	12.96	6	11.76	8	14.04
3	Working age	64	59.26	29	56.86	35	61.40
3.1	Employed	47	43.52	21	41.18	26	45.61
3.2	Unemployed	3	2.78	1	1.96	2	3.51
3.3	Student (over 15 years old)	10	9.26	6	11.76	4	7.02
3.4	Others	4	3.70	1	1.96	3	5.26

Source: ESC's survey conducted in May 2024

Livelihood Engagement

According to household interview results, wage-based livelihood group (rubber harvesting workers, general workers, teachers, nurses, and officers) are the predominant occupation in the surveyed communes. Among the 52 people directly involved in the work mentioned in previous section, the wage-based livelihood group holds the highest proportion at 44.2% (23 people) which is higher than the trade and service group which accounts for 30.8% (16 people) and agricultural activities (including husbandry, fruit gardening and rice/short-term crops plantation) which accounts for 25% (16 people). It is worth noting that the information gathered from the interviews may encompass people's secondary occupations, like farmers engaging as rubber harvesting workers during their free time between crop seasons.

Table 5-19: Livelihood by commune

No.	Livelihood groups	All surveyed area (N=52)		Lai Uyen (N=24)		Tru Van Tho (N=28)	
		N	%	N	%	N	%
1	Wage-based	23	44.23	15	62.50	8	28.57
1.1	Rubber harvesting worker	8	15.38	7	29.17	1	3.57
1.2	General worker	7	13.46	4	16.67	3	10.71
1.3	Teacher/Nurse/Officer	8	15.38	4	16.67	4	14.29
2	Trade and service	16	30.77	4	16.67	12	42.86
3	Agriculture-based	13	25.00	5	20.83	8	28.57
3.1	Husbandry	3	5.77	3	12.50	0	0.00
3.2	Rice/crops plantation	10	19.23	2	8.33	8	28.57

Source: ESC's survey conducted in May 2024

The gender ratio of the people directly engaging in work is 56:44 with 29 males and 23 females. The gender ratio in the wage-based livelihood group is quite similar. However, in the other livelihood categories, there are significant differences. The number of female in trade and service group surpasses that of males, while in agricultural activities, the proportion of male workers is higher.

5.14.3 Income and Expendirture

Income

The average monthly household income of the 25 surveyed households is 25.6 million VND, and the average monthly income per capita is 5.87 million VND. Lai Uyen townlet has the minimum average monthly income per household and per capita with 7.1 million VND and 1.78 million VND respectively. The maximum average monthly incomes per household and per capita are recorded in Tru Van Tho commune, at 98.3 million VND and 25.58 million VND respectively. Based on the survey findings, no household fall into the category of poor or near poor households due to their monthly income per capita being below the poverty level[48].

Table 5-20: Average Monthly Income Per Household and Per Capita

No.	Income (Mil. VND)	All surveyed areas (N=25)	Lai Uyen (N=11)	Tru Van Tho (N=14)
1	Monthly average income per household	25.6	20.1	30.2
2	Minimum monthly income per household	7.1	7.1	9.8
3	Maximum monthly income per household	98.3	59.2	98.3
4	Monthly average income per capita	5.87	4.34	7.29
5	Minimum monthly income per capita	1.78	1.78	2.03
6	Maximum monthly income per capita	25.6	6.56	25.58

Source: ESC's survey conducted in May 2024

Expenditure

The monthly average expenditure per household is 15.13 million VND and the monthly average expenditure per capita is 3.47 million VND. The minimum monthly expenditure per household is 5.0 million VND, in Tru Van Tho commune. The maximum monthly expenditure per household is 29.7 million VND, in Tru Van Tho commune.

Table 5-21: Average Monthly Expenditure Per Household and Per Capita

No.	Expenditure (Mil. VND)	All surveyed areas (N=25)	Lai Uyen (N=11)	Tru Van Tho (N=14)
1	Monthly average expenditure per household	15.13	13.9	16.1
2	Minimum monthly expenditure per household	5.0	8.0	5.0
3	Maximum monthly expenditure per household	30.0	21.0	30.0
4	Monthly average expenditure per capita	3.47	2.99	3.89
5	Minimum monthly expenditure per capita	1.60	1.71	1.60
6	Maximum monthly expenditure per capita	6.25	4.33	6.25

Source: ESC's survey conducted in May 2024

[48] According to Decree No.07/2021/NĐ-CP dated January 27th, 2021 by the Government on multidimensional poverty for the period 2022-2025, poverty levels for those living in rural areas for poor and near poor households are under 1,500,000 VND/month/capita and not eligible for at least three basic social services.

Overall, the survey findings indicate that the household income is sufficient to cover all the households' expenses. However, there is one household (4%) who reported that their income is inadequate to cover their expenditures. This discrepancy might be attributed to the respondents not recalling all their expenses in detail throughout the year during the survey.

To cope with their financial challenges, these households resorted to various measures. They borrowed money with interest from banks primarily relying on past loans (40%) and borrowed from friends and relatives (45%). Additionally, they received support from rural development funds (4%), utilized their past savings (5%), sold their property (3%), or borrowed from friends or relatives without interest (3%).

Among the expenditure categories of the surveyed households, the highest portions were allocated to regular living expenses (47.2%). Furthermore, a significant portion of the budget was allocated to cover medical expenses (6.9%) and expenses for social/community activities (8.9%). More detailed information can be found in the table below.

Table 5-22: Average Monthly Household Expenditure by Spending Items

No.	Items	All surveyed areas (N=25)		Lai Uyen (N=11)		Tru Van Tho (N=14)	
		Monthly expenditure (mil VND)	%	Monthly expenditure (mil VND)	%	Monthly expenditure (mil VND)	%
I	**Regular living expenses (food, electricity, water, travel expenses, communication, etc.)**	**7.14**	**47.2**	**6.65**	**47.8**	**7.64**	**47.5**
1	Buying food for the family	4.83	31.9	4.54	32.7	5.12	31.8
2	Expenses for electricity, water, living energy	0.92	6.1	0.71	5.1	1.13	7.0
3	Fuel/travel expenses	0.62	4.1	0.53	3.8	0.71	4.4
4	Communication (telephone, internet, cable TV)	0.28	1.9	0.2	2.0	0.28	1.7
5	Education expenditure (school money, books, school supplies)	1.18	7.8	1.41	10.1	0.94	5.8
II	**Other irregular living expenses (weddings, funerals, shoes, SMthes, medical care, etc.)**	**2.86**	**18.9**	**2.96**	**21.3**	**2.75**	**17.1**
6	Medical expenses (common medical examination and treatment, medicines, etc.)	0.59	3.9	0.60	4.3	0.57	3.5
7	SMthes and shoes for the family	0.51	3.4	0.54	3.9	0.46	2.9
8	Social/community activities (weddings, funerals, anniversaries, Tet, other parties…)	1.35	8.9	1.26	9.1	1.42	8.8
9	Debt interest payment	0.41	2.7	0.56	4.0	0.30	1.9
III	**Other unexpected expenses (building houses, repairing**	**5.13**	**33.9**	**4.29**	**30.9**	**5.71**	**35.5**

No.	Items	All surveyed areas (N=25)		Lai Uyen (N=11)		Tru Van Tho (N=14)	
		Monthly expenditure (mil VND)	%	Monthly expenditure (mil VND)	%	Monthly expenditure (mil VND)	%
	houses, paying interest, buying land, etc.)						
10	House repair	0.29	1.9	0.09	0.6	0.44	2.7
11	Medical expenses for serious illness/accident	0.45	3.0	0.17	1.2	0.60	3.7
12	Inputs for family production needs	2.50	16.5	2.03	14.6	2.87	17.8
13	Other expenses	1.89	12.5	2.00	14.4	1.80	11.2
		15.13	100.00	13.9	100.00	16.1	100.00

Source: ESC's survey conducted in May 2024

5.14.4 Land, housing and assets

Land and House Ownership

Majority of the surveyed households (96% or 24 households) utilize land with land use rights certificate (LURCs). Additionally, only one household (4%) in Tru Van Tho commune is residing on land that they have borrowed for residential purposes.

Out of the 24 surveyed households with LURCs, 100% owns residential land and garden land, with an average area of 1,581m2. The largest and smallest land areas owned by surveyed households are 7,500 m2 and 100 m2, respectively, both located in Tru Van Tho commune. The garden land serves various purposes, such as cultivating vegetables and fruit trees for the family's daily needs and setting up living facilities like wells and water pumps. Furthermore, 17 surveyed households (68%) own agricultural land, with an average area of 23,726 m2, with the coresponding figures of the largest and smallest land areas of 60,000 m2 and 1,000 m2. All 17 households owned these lands with LURCs.

One-storey permanent house[49] is the typical house design in the surveyed areas, accounting for 80% of 25 surveyed households. In addition to 16% of the multi-storey house, there is one household living in non-permanent house in Tru Van Tho commune.

Household Assets

The findings from survey data reveal that grid power is available throughout the entire study area, and all the surveyed households currently have access to it. Moreover, all households possess communication devices (such as mobile phones), private toilets, transport vehicles (mainly motorbikes), furniture (beds, cabinets), and basic home appliances (such as televisions and refrigerators). Washing machines are also available for the majority of households. However, utilities like computers/laptops, and cars are available in some surveyed households (under 50%).

[49] According to the definition of the Ministry of Construction on permanent and semi-permanent houses, there are three criteria to categorize permanent house and semi-permanent house. In particular, permanent house is a house meets all three criteria, and semi-permanent house is a house meets two criteria. The criteria include: (1) Pillar made of materials: concrete, brick/stone, iron/steel/ durable wood; (2) Roof made of materials: concrete, tile (cement, terracotta); (3) Wall made of materials: concrete, brick / stone, wood/metal

Table 5-23: Household Asset Items by Commune

No.	Utility	All surveyed areas (N=25)		Lai Uyen (N=11)		Tru Van Tho (N=14)	
		No. of HH	%	No. of HH	%	No. of HH	%
1	Grid power	25	100.0	11	100.0	14	100.0
2	Mobile phone	25	100.0	11	100.0	14	100.0
3	Private toilet	25	100.0	11	100.0	14	100.0
4	Motorcycle	25	100.0	11	100.0	14	100.0
5	Furniture	25	100.0	11	100.0	14	100.0
6	Refrigerator	25	100.0	11	100.0	14	100.0
7	Television	25	100.0	11	100.0	14	100.0
8	Washing machine	22	88.0	9	81.8	13	92.9
9	Computer	10	40.0	3	27.3	7	50.0
10	Car	8	32.0	2	18.2	6	42.9

Source: ESC's survey conducted in May 2024

Energy Source for Cooking

The most prevalent energy source utilized by the surveyed households for cooking is gas, which is used by 19 households (76%) out of the total 25 surveyed households. Among these, nine households are from Lai Uyen townlet, and the remaining 10 households are from Tru Van Tho commune. Electricity is the second choice of energy source for cooking, being used by 6 households (24%). None of the households rely on firewood, coal or biogas energy for cooking.

Water Source

Based on the survey results, both Lai Uyen and Tru Van Tho communes have access to supplied water tap, but there is a significant disparity in the coverage and number of households using water tap between the two. In Lai Uyen townlet, only one out of 11 surveyed households (9.1%) use supplied water, while in Tru Van Tho commune, nine households out of 14 (64.3%) access to water tap as the main water source. The rest of surveyed households use underground water wells. As shared by the respondents, although they can register for clean water supply installation, they reckoned that water from borewell is sufficient and adequate for household use. All households have flushing toilets as a minimum requirement for sanitation.

5.14.5 Community Health

Local Health Facilities Use

Both Lai Uyen and Tru Van Tho communes are equipped with communal-level medical centers that offer essential first aid and basic treatment services and the survey respondents may access different health establishments. According to the survey results, the health care establishment most commonly chosen by the surveyed households is the district hospital in Bau Bang or Ben Cat (48%), followed by the commune medical center (36%), provincial/city hospitals in Thu Dau Mot or Ho Chi Minh City (16%).

Common Diseases

During the last 12 months, flu was the only reported communicable disease in the survey areas, affecting two surveyed households (8%), with either the household head or one of the household members contracting it. Additionally, respondents also reported cases of osteoporosis and arthritis issues (20%).

Other diseases were recorded, albeit in smaller numbers. These included cases of diabetes (8%), gastrointestinal (8%) and accident which leads to epilepsy (8%).

5.14.6 Social networking and gender analysis

Social networking

Out of 25 interviewed households, the three important sources when they need help (in terms of finance, information and spiritual support) are family (72%), friends (32%), and neighbors (20%). Other answers also mentioned about associations/unions (4%) and local authorities (4%). More than 50% of households do not participate in any social networking activities, the table below illustrates the common associations/unions participation of respondents.

Table 5-24: Association/Unions participation by commune

No.	Associations/Unions	All surveyed areas (N=25)		Lai Uyen (N=11)		Tru Van Tho (N=14)	
		No. of HH	%	No. of HH	%	No. of HH	%
1	No partipation	13	52.00	7	63.64	6	42.86
2	Women's Union	7	28.00	2	18.18	5	35.71
3	Farmer's Union	7	28.00	2	18.18	5	35.71
4	Elderly Association	2	8.00	0	0.00	2	14.28
5	Red Cross Union	2	8.00	1	9.09	1	7.14
6	Religious Group	2	8.00	2	18.18	0	0.00
7	Fartherland Front	1	4.00	0	0.00	1	7.14

Source: ESC's survey conducted in May 2024

Gender analysis

There is no profound gender differentiation among surveyed households in terms of labour division in household work and community affairs. Both women and men share housework, children care, and income generation activities. There is a more balanced role between males and females in engaging in reproduction activities, except for two household in Lai Uyen commune who are female-headed household. While women are still undertaking housework and family care, the role of the man in helping women is increasingly promoted, such as they even go to the market and cook for the whole family. In production activities, men seem to have a more prominent role and contribution, 70%, since most of the heavy farming jobs and trading are led by males. In all surveyed villages, men and women use and control household resources equally. Women and men discuss to make decisions on household related issues. For issues in family such as daily expenditure, women are decision makers. Big decision is considered by both husband and wife, however, men normally have the right to make final decisions because they are regarded to be main labours and more thoughtful than their counterparts. For social and community activities, in all surveyed villages the tendency of equality between men and women in work assignment is relatively clear. Both men and women have an equal chance to participate in meetings, as well as in community activities. However, at meetings related to land and compensation, men are more involved as both men and women believe that men have better knowledge and understanding about this issue to handle.

5.14.7 Vulnerability analysis

To analyze the vulnerable households in the surveyed area, they are defined as meeting at least one of the following criteria:

- Households with physically/mentally disabled members;
- Female-headed households (household in which an adult female is the sole or main income producer and decision-maker) with dependents;
- Households whose main earner is the elderly (>60 years old) with no other means of support;
- Households belong to ethnic minority groups;
- Households with orphans under 16 years old with no other means of support;
- Households whose main earners are illiterate;
- Poor and near-poor households certified by the Government;

Out of the surveyed households, two households in Lai Uyen townlet (8%) have been categorized as vulnerable, comprising seven vulnerable individuals (6.5%) belonging to these vulnerable households out of the total 108 household members. Within these two vulnerable households, one female-headed household with four members and one female headed-household (3 people) with a mentally disabled member.

The first household mentioned above as female headed-household including 4 people - a widowed woman (61 years old), her daughter (30 years old) and two grandchildren (less than 6 years old). In term of education, both of women in this household were not completed secondary school. The head of household is working as a rubber harvesting worker but the working status is temporary. Her daughter occupies as a worker in a manufacturing factory in Bau Bang industrial zone. This household used to be classified as a poor household but they escaped poverty in 2019. The monthly incomes of this household is estimated as around 7 millions VND, however their monthly expenditure is approximately 8 millions VND, which leads to their financial issue (a loan from rural development fund). Their assets are a permanent charitable house on a 500 square meters residential/garden land with LURC and a few poultry. In term of health, the head of household has been suffered osteoporosis and arthritis issue.

The second household with a mentally disabled member including 3 individuals – a widowed woman (49 years old) and two sons (25 years old and 8 years old). She is the only Buddhist adherent in this household and working as a freelance psychic while her first son is working as a freelance motorbike mechanic. In term of education, the household head and her first son completed high school level and secondary school while her second son is illiterate due to epilepsy. The total monthly income expenditure are about 15 millions VND and 9 millions VND, respectively. Her assets include an one storey permanent house and about 2,000 m2 agricultural production land. Her second son is mentally disabled due to accident which leads to epilepsy and get social assistance.

5.14.8 Local Perception about the Project and impacts

Public utilities satisfaction

The results of satisfaction scale on local infrastructures and services could be summarised in the table Table 5-25.

Table 5-25: Public ultilities satisfaction

Infrastruture and service	Average satisfaction rate	Satisfaction rate answers			
		Very Good (9-10)	Good (7-8)	Normal (5-6)	Bad (<4)
Electricity	7.6	1	24	0	0
Road	6.9	0	18	7	0
School	7.4	1	22	2	0
Medical center	7.6	1	24	0	0
Water resource	8.2	1	24	0	0
Domestic waste collection and treatment	8.2	1	24	0	0
Internet and telecomunication	8.2	1	24	0	0
Market	8.5	2	23	0	0
Average (N = 25)	7.8	1.0	22.9	1.1	0

Project Acknowledgement

Out of the 25 surveyed households, six of them (all in Lai Uyen townlet) reported that they had never heard about the Project before the interview and were only introduced to it during the interview. Furthermore, a significant number of households, 17 in total, became aware of the Project within the last 12 months. Only two households in Tru Van Tho commune knew about the Project for more than 1 year prior to the interview.

The 19 surveyed households who were aware of the Project, may obtain the Project information through various sources. Specifically, five households in Lai Uyen townlet and 12 households in Tru Van Tho commune (totally 89.5%), received the information via project officers, two households knew about the project via their neighbors/relatives and only one household in Tru Van Tho commune obtained the information from the local authority. This indicates that the information about the Project was widely disseminated within the community even before it was officially provided by the local authority.

Table 5-26: Local perception about the project by commune

No.	Information channel	All surveyed areas (N=25)		Lai Uyen (N=11)		Tru Van Tho (N=14)	
		N	%	N	%	N	%
1	Project officers	17	68.00	5	45.45	12	85.71
2	Neighbors/relatives	2	8.00	0	0.00	2	14.29
3	Local authority	1	4.00	0	0.00	1	7.14
4	Never heard about the project	6	24.00	6	54.55	0	0.00

Source: ESC's survey conducted in May 2024

Local Concerns and Expectations Relating to the Project Development

Regarding local concerns on the project development, air and noise quality degrading with the potential impacts of soil erosion and increasing vehicles/traffic disruption as the two most significant issues among the surveyed households, with 60% and 56%, respectively. These concerns primarily stemmed from the lack of information disClosure on mitigation measures about the Project and apprehensions regarding the potential effects of the pipeline civil works in the area.

The surveyed households also expressed worries that the Project might impact their household businesses of cultivation/trade areas (24%) located surrounding construction areas, as well as their loss of land and assests (28%). Their concerns also expressed in changes and temporary disruptions in the living environment (20%).

In terms of their expectations, the surveyed households placed the highest priority on the E&S during and after the construction phase of the Project as they were directly concerned about the potential adverse effects on their health caused by the noise and dust from construction activities (48%). Additionally, they hoped for adequate compensation (48%) for the land affected by the Project to enable them to establish new crops. Most of households expect the project will create new job opportunities (24%) and promote of local development (64%).

Table 5-27: Concerns and expectations of the surveyed households

No.	Concerns/expectations	Number of households	Percentages (%)
1	No concerns/expectations	8	32
2	Promoting local development	16	64
3	Bringing more job opportunities	6	24
4	Being adequately compenstated	12	48
5	Increasing vehicles and traffic disruption	14	56
6	Health issues causing by civil works	12	48
7	Impacts from dust, noise and soil erosion	15	60
8	Limited access to production/trade areas	6	24
9	Changes in the living environment	5	20
10	Loss of lands and assets	7	28

Source: ESC's survey conducted in May 2024

6. ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

The impact assessment and mitiation measures were done by ESC when final alignment - Option 3 was not developed for the IESE report preparation (Option 3 was finalized in Sep 2024 after the Draft IESE was completed). As such, the impact assessment and mitigation measures in this report are for Option 2 alignment. Should there be significant changes in the impact assessment and mitigation measures, TDM is to update accordingly to ensure compliance with ADB and JICA's requirements.

6.1 Project Environmental and Social Benefits

The water supply expansion project is anticipated to have significant localized social and economic benefits including:

- **Enhanced Water Availability**: The expanded water supply project increases the overall capacity to treat and distribute water, potentially meeting the growing demand for clean water in the community. This can reduce pressure on local water sources and contribute to improved water availability;
- **Reduced stress on groundwater**: Drawing water from the Dau Tieng – Phuoc Hoa canal can help reduce the reliance on groundwater resources. This is crucial for preventing over-extraction, preserving aquifers, and avoiding land subsidence issues associated with excessive groundwater withdrawal, which is a serious problem in Ho Chi Minh City and surrounding regions;
- **Enhanced Resilience to Climate Change**: An expanded water supply system, with updated infrastructure and increased capacity, is better equipped to handle challenges posed by climate change, such as variations in precipitation patterns and extreme weather events;
- **Promotion of Sustainable Urban Development:** Adequate water supply is a crucial component for sustainable urban development. The project expansion would support the growth of the community, providing essential water services for residential, commercial, and industrial purposes in Binh Duong province.

Naturally, to sustain these benefits, proper operation and maintenance of the services and facilities are required.

6.2 Environmental and Social Impact Screening

This chapter screens the potential impacts linked to project activities according to the following factors and recommends mitigating activities on this basis:

- "Receptor": the resource (human/natural environment/economic/social) which is potentially going to receive and have to cope with an impact;
- "Sensitivity": ability to cope with an impact and/or its importance to Vietnam. It is generally accepted that human health is always a high sensitivity receptor, however in terms of environmental/natural resources, the sensitivity varies according to the receptor e.g. scrubland with no significant biodiversity is considered less sensitive than a water body which supports ecosystems and livelihoods through fishing;
- "Magnitude": the size of the potential impact. Impacts may be short term and considered low magnitude (e.g. noise or temporary reduction of income during a short construction project) or high magnitude and long term (e.g. the pollution of surface and ground water quality).

Where an impact may occur, if there is no receptor to potentially receive the impact, then mitigating actions will not be required. This follows the source-pathway-receptor model, whereby in order for there to be an impact, the pollutant or issue (source) needs to be present, the pathway to a receptor is needed (such as fissures in rocks, or water for human consumption) and a receptor must be present to receive the impact, such as humans, physical and ecological resources /flora or fauna.

Table 6-1: Screening of Impacts

E&S Impacts	Description of Impact	Sources of Impact	Receptors
Construction			
Noise	- Construction-related machinery and activities may generate noise and vibrations, potentially affecting local wildlife and communities. - Noise pollution can disturb natural habitats and interfere with animal communication	- Noise from construction equipment - Earthworks - Heavy equipment	- Nearby residents along the first 2km pipeline - Road users - About 100 workers living onsite in camps
Air Quality	- Exhaust fumes from construction machinery and equipment, movement of haulage trucks - Fugitive dust from earth works, loading, unloading and haulage of construction materials - Construction-related dust and air pollutants can contribute to particulate matter in the air, affecting respiratory health	- Construction-related dust - Exhaust emissions	- Nearby residents along the first 2km pipeline alignment - Road users - Workers -
Water quality and hydrology	- Construction activities can result in increased turbidity and sedimentation in nearby water bodies. This can degrade water quality by reducing clarity and introducing sediments	- Construction runoff - Sedimentation from disturbed areas - Accidental spills/ poor management of waste	- Local stream - Groundwater - Water dependent organisms
Waste generation and management	- Construction activities generate waste materials, including debris and discarded materials.	- Construction debris, discarded materials	- Local waste management systems, landfill areas
Land-use and Livelihoods	- Construction activities will temporarily acquire land and restrict access to farms and houses, which may lead to temporary economic displacement impacts.	- Temporary land access and use restrictions	- Local farmers - Existing garden land and agricultural production land

E&S Impacts	Description of Impact	Sources of Impact	Receptors
Infrastructure and Service	- Increased construction-related traffic may lead to congestion and potential safety hazards. - Construction traffic can disrupt normal traffic flow, leading to safety concerns for both motorists and pedestrians. - Reduced / degraded accessibility	- Excavation works/ trenches in public areas - Presence of equipment in public areas - Construction vehicles, increased traffic flow	- Local traffic - Road safety - Nearby communities
Community Health and Safety	- Influx of non-local construction workers could change the disease profile in the community health and well-being - Project emisssions (dust, noise, waste) discharge to surrounding communities - Security risks and social conflicts between local communities and immigrants - Road occupation during construction and road use by additional traffics during construction may post potential traffic incident/ accident	- Presence of construction works in public areas - Influx of labour force for the construction work - Road occupation during pipe laying, and additional traffics	- Nearby communities and road users
Occupational Health and Safety	- Construction site activities, such as the operation of heavy machinery, pose potential risks to workers' health and safety - Risk of infections	- Construction site activities, operation of heavy machinery - Influx of labour force for the construction work	- On-site workers and personel - Communities
Cultural heritage	- Excavation works can contact unknown heritage resources, particularly archaeological resources	- Excavation works	- Unknown heritage resources
Operation			
Waste and sludge generation	- Generation of solid waste and sludge from plant operations, including residuals from water treatment processes	- Residuals from treatment processes, facility maintenance	- Local waste management systems, landfill areas
Chemical Usage and Storage	- Use and storage of chemicals for water treatment. Potential risks associated with chemical spills or leaks	- Chemical treatment processes, storage facilities	- Local water bodies, soil quality
Aquatic life at the intake points	- Aquatic species living or passby near the intake point may be drawn into the intake structure.	- Strong current at the intake	- Fish and aquatic life

E&S Impacts	Description of Impact	Sources of Impact	Receptors
	- Fishes were observed in the water reservoir during site visit (for a separate ESMS audit scope in August 2023) and that there is no screening structure provided at the intake facility to prevent any potential fishes entering. It should also be noted that the local EIA baseline survey of aquatic life at the intake point indicated a low biodiversity value, with no rare or endangered species identified.		
Occupational Health and Safety	- Operation and maintainance activities, such as the working with chemical mixing system, pose potential risks to workers' health and safety	- Chemical treatment processes, storage facilities	- Operators and workers
Community Health and Safety	- Operational accidents affect to local communities - Transportation of workers and security issues - Inproper waste managment	- Chlorine storage - Waste storage	- Local communities surrounding project area

6.3 Impact Assessment Methodology

6.3.1 Significance

In general, impact significance is determined through a combination of receptor sensitivity and magnitude of change to that receptor. Impacts within the IESE will be identified, and significance assessed, in a structured manner which accounts for this sensitivity and magnitude interaction as presented in the table below.

Table 6-2: Determining Impact Significance

		Impact Magnitude			
		Negligible	**Small**	**Medium**	**Large**
Sensitivity of Impact Receptors	**Negligible**	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Negligible	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Major
	High	Minor	Moderate	Major	Major

The resultant impact significance is as generally described below. However, this may vary between various technical specialties, particularly where numerical standards (rather than qualitative evaluation) are utilized in determining impact magnitude. The descriptions below, while drawing upon international best practice, have been adapted for the purposes of Vietnamese context.

Table 6-3: Description of impact significance

Impact Significance	Definition
Negligible	Insignificant impact: ▪ Magnitude of the change is still within the limits of its natural variation ▪ Impact is quite low and localized ▪ Low probability of impact occurrence ▪ Impact is reversible in a short period
Minor	Insignificant impact: ▪ Magnitude of the impact is relatively small and the probability of impact occurrence is low ▪ Impacts on physical and chemical environmental components are within the applicable environmental quality standard ▪ Impact is reversible
Moderate	Significant impact: ▪ Moderate impacts occurring over short period ▪ Environment has enough time to recover its condition (homeostasis) ▪ Benefits of project existence are limited to few number of communities (people) ▪ Project activity has an irreversible impact, but impact is moderate ▪ There is a conflict of interest in the use of various natural resources (agriculture, forestry, recreation, water resources, etc.) and other established uses in the project area ▪ Impacts need to be managed effectiv ely and efficiently so that the magnitude of the impact is reduced to a level of 'as low as reasonably practical' (ALARP)
Major	Significant impact: ▪ Impact is classified as major when affecting a large proportion of the community (people) ▪ Impact exceeds the applicable environmental quality threshold ▪ Disturb and/or have a negative impact on property of cultural significance to a community or ethnic or social group ▪ Projects cause significant population growth or population concentration ▪ Project converts productive (prime) agricultural land to non-agricultural use ▪ Impacts need to be managed effectively and efficiently so that project activities do not cause large residual impacts over a long period of time and over a large area

Both receptor sensitivity and magnitude themselves require structured and rigorous multi-factor assessment before being utilized within the impact significance matrix. These are further described below.

6.3.2 Magnitude

The assessment of impact magnitude is generally undertaken across two steps. First, the identified impact is categorized as either beneficial or adverse. Secondly, impacts will be categorized as large, medium, low, or negligible based on consideration of parameters such as:

- Impact Duration: this ranges from “beyond decommissioning” to “temporary with no detectable impact”;
- Spatial extent of the impact: for instance, within the site boundary, to within village, province, national or trans-boundary;
- Reversibility: ranging from permanent requiring significant intervention to return to baseline to no change;
- Likelihood: ranging from occurring regularly under typical conditions to unlikely to occur; and
- Compliance with legal standards and established professional criteria. These are often discipline-specific and range from “substantially exceeds national standards or international guidelines" to “meets standards” (i.e., impacts are predicted to be less than allowed by a quantitative standard).

The table below presents generic criteria utilized in determining impact magnitude. Each detailed technical assessment will define impact magnitude in relation to its environmental or social aspects.

Table 6-4: Criteria for determining impact magnitude

Magnitude (beneficial or adverse)	Definition (consider duration, spatial extent, reversibility, and emission standards compliance)
Large	Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature and requiring significant intervention to return to baseline; would violate National Standards, IFC PS or GIIP without additional mitigation
Medium	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change
Small	Detectable but small change to the specific conditions assessed
Negligible	No perceptible change to the specific conditions assessed

6.3.3 Sensitivity

Sensitivity is specific to each aspect and the environmental resource or human population affected, with criteria developed from established baseline information. Generic criteria for determining sensitivity of receptors are outlined in the below table. The detailed technical assessments will define sensitivity in relation to the environmental or social aspect.

Table 6-5: Receptor sensitivity definitions

Sensitivity	Definition
High	Receptor (human, physical or biological) with little or no capacity to absorb proposed changes and/or minimal opportunities for mitigation
Medium	Receptor with little capacity to absorb proposed changes and/or limited opportunities for mitigation
Low	Receptor with some capacity to absorb proposed changes and/or reasonable opportunities for mitigation
Negligible	Receptor with good capacity to absorb proposed changes or good opportunities for mitigation

6.4 Environmental Impacts during Construction and Mitigation Measures

6.4.1 Noise

Potential Impacts

During construction phase, noise will be generated from construction activities such as land clearance, earth works, excavation, mobilizing of equipment/ machinery, and transportation of materials and workforce influx, civil works for the Bau Bang WTP Expansion (piling, foundation, concreting etc.), pipeline laying and backfill, and finishing and reinstatement works. Noise sources are from equipment's engine, usually a diesel, without sufficient muffling, such as pumps, generators, compressors, pile drivers, pavement breakers, bulldozers, loaders, trucks, etc. The percussion piling required during the preparation of the WTP foundations will specifically generate moderate noise levels.

Impacts Evaluation

Bau Bang WTP and its associated facilities are located in a remote area where sensitive receptors were identified as Negligible. About less than 10 households are found to be more than 300m away from the Bau Bang WTP compound boundary. In addition, even the construction phase of the WTP expansion will be lasted for at least 1 year, the Bau Bang WTP compound is still surrounded by rubber trees forest which is noise absorber. Therefore, the impact magnitude to these group of households are assessed as Small.

The baseline results show that the noise level of surrounding the Bau Bang WTP at 3 locations (nearest households) were within the limit of national standard (QCVN 26/2010-BTNMT) but slightly exceed the IFC EHS Guideline 2007 noise limit for both daytime and nighttime. Construction works will be carried out only during day time for about a year, so there will be no noise impact at night. With the distance of more than 300m away, if the construction noise is about 120dBA, reduced noise level at receptors will be well below 70dBA as noise reduce by distance and especially over the rubber tree forest. As such, resident can easily absorb the insignificant noise changes during the shorterm construction of the WTP expansion facilities. The Sensitivity of receptors from noise during the Bau Bang WTP expansion facilities construction is therefore assessed to be Low, resulting in Minor impact significance.

As for construction works along the proposed 8.3km pipeline alignment, construction works by open cut method involves mainly excavation, laying the pipeline and backfill, which noise generation is much lessor compared to concrete works. As construction works will be carried out by segment, duration for each segment of 1km construction is likely to be about 2-4 weeks. As noise will stop when construction stops, noise impact will be temporary, short term, non continuous and consider to be detectable but small change to the site noise levels. The magnitude is assessed to be Small.

Most of sensitive receptors potentially be affected by the pipeline installation are located in Segment 1 (from Tru Van Tho pump station, crossing DT750 Provincal Road before terminating at a plantation area). The installation works are expected to be distanced at least 5-10 meters from the surrounding communities. With the rolling method of pipeline installation, for each 500-meter length, it may take up to 2 weeks to be complete. The baseline result at the DT750 junction was within the limit of national standard (QCVN 26/2010-BTNMT) but slightly exceed the IFC EHS Guideline 2007 noise limit for both daytime and nighttime. In addition, the junction is the provincial road – one of the key main road in Binh Duong province, which noise from hevicle passing by will occasionally exceed limits. The households living here are therefore familiar with urban-like noise conditions, and have some capacity to absorb the temporary increased noise for 2-4 weeks during day time occasionally. The sensitivity of this segment receptors are assessed as Low. The noise impact from the proposed pipeline construction is hence assessed to be Minor significance.

Mitigation Measures

The following in built mitigation measures are recommended to minimize noise impact during construction:

- All construction equipment would be required to be equipped with well-maintained mufflers and other sound control devices;
- Noisy portable equipment, such as generators and compressors, would be located as far away from residential receptors as practical and muffled within enClosures;
- Equipment would not be allowed to idle for long periods of time; equipment not being used would be shut off;
- Construction haul routes would be designated to minimize impacts on residential receptors;
- Limit the construction hours to be during day time only from 7.30 am-5pm. Noisy construction should not be carried out during nap time after lunch (12pm – 1pm) when pipeline is installed along DT750 Provincal Road junction; and
- Avoid operating several noise equipment and construction activities at the same time to reduce combined noise levels.

Residual Impacts

Residual impact after mitigation measures is still **Negligible**.

6.4.2 Air Quality

Potential impacts that may temporarily degrade air quality from construction works, such as dust emissions and vehicle exhaust emissions, are discussed in this Section.

Potential Impacts

The primary source of fugitive dust emissions from the construction works are likely to be generated from the construction worksites. The construction works which may have the potential to create considerable dust concentrations include the following:

- Site preparation works including site clearance and boundary fence installation;
- Foundation and excavation work including drilling, spoil handling and transport;
- Stockpiling and material handling e.g., delivery, loading/unloading friable materials and use of construction aggregates;
- Excavation;
- Vehicle movement on exposed soil and unpaved roadways and material tracked out from active earthwork areas and deposited on local roads;
- Reinstatement works; and
- Wind erosion at earthwork areas, exposed soil areas and stockpiled construction materials.

The actual quantities of dust entrained will be dependent on a number of factors including the frequency and duration of operations, the specific operations being carried out, the ambient weather conditions (wet or dry, calm or windy), the soil conditions (including the particle size distribution, silt and moisture content), the site areas, the quantity of material being handled and construction vehicles' quantity, routing and the transit speeds. Dust emissions can therefore be expected to vary significantly from day to day.

During the construction phase, heavy vehicles and machineries such as trucks, lorry cranes, portable generators, excavators and welding machines will be used. The engine exhaust emissions of the vehicles and machines contain NOx, SO2, CO, particulates (PM2.5, PM10) and smoke. Exhaust emissions from these sources can cause direct negative effects to the local air quality by increasing the concentrations of PM2.5, PM10, NO2, SO2, and CO, which in turn may cause negative effects to nearby air sensitive receivers nearby.

Impacts Evaluation

As previously described, survey for baseline air quality during EIA preparation indicated that the concentration of all air pollutants measured during the monitoring surveys were within the thresholds prescribed in the QCVN 05:2013/BTNMT and IFC General EHS Guidelines 2007. Therefore, the ambient air quality in the Project area and its vicinity has been evaluated in good condition.

The use of construction vehicles and equipment during construction and material handling works will decrease the air quality and increase local dust levels. Emission from heavy vehicles may also increase slightly the concentration of pollutants such as CO, NO2 and SO2. However, this impact is considered **temporary** and will stop as soon as the construction stop.

The most significant source of emissions during the construction phase is fugitive dust from various construction activities, including the expansion of Bau Bang WTP and the installation of the 8.3km pipeline. It has been reported that no residential areas are recorded within the 300m buffer zone from the boundary of the existing Bau Bang WTP compound, where the WTP expansion facilities are located. Receptors affected by air quality impacts from the construction of the 8.3km pipeline have been identified, including:

- Households along the first pipeline segment, starting from Tru Van Tho pumping station (1.35km).
- Residents and road users at pipeline's intersection with DT750.
- Some local farmers who may work during the daytime in the agricultural area

The decrease in air quality is expected to be Negligible to the identified receptors, or in other words, the receptors will have some capacity to absorb the proposed changes. Hence, the receptors at the sites are **Low Sensitivity** to air quality impacts.

The quantity of dust and air pollutants generated by earthworks are expected to be low and localized. In addition, the ambient environment is mostly vegetation and rubber forest which is air absorben, help absorb the air pollution generated from the construction works. Air quality impacts is hence detectable but cause small change to the environment, which defines **Minor Magnitude**.

In the absence of mitigation measures, the significance of this impact has been evaluated as **Minor.**

Existing Controls

The draft EIA (TDM, 2024) has proposed the following preventive measures to cope with dust and exhaust emissions during the construction:

- Develop a construction schedule and arrange a suitable workforce to minimize dust generation.
- Conduct excavation and grading activities on days with low wind to reduce dust dispersion.
- Provide appropriate Personal Protective Equipment (PPE), including protective gear, for workers at the project site.
- Utilize all excavated soil on-site to eliminate the need for transporting soil off the project site.
- Spray water to moisten areas prone to dust emission. Apply water at least twice daily, preferring multiple small applications over one large one. Water should be sourced from on-site wells.
- Install 3m high metal fences around the project to prevent dust dispersion towards surrounding crops, minimizing its impact on the productivity and aesthetics of local residents.
- Organize teams to regularly clean main roads within the construction site and worker entrance areas to collect soil, sand, and debris resulting from material transportation.
- Periodically inspect and maintain construction machinery to reduce emissions.

<u>Mitigation Measures for Dust Generation from Material Transportation</u>

- Ensure compliance with general transport regulations, such as covering material transport vehicles with lids or securely fastened tarps. Avoid overloading.
- Clean vehicles before entering transportation routes by mechanically removing mud and dirt from tires at entry points.
- Schedule material transportation during non-peak hours to limit the transport of soil and rocks on local roads.
- Deploy cleaning crews regularly to clear material debris spilled during transportation, preventing accidents for road users and ensuring environmental hygiene.

Mitigation Measures for Exhaust Emission from Metal Cutting and Welding

- Equip welders with appropriate PPE, including protective SMthing, gloves, welding helmets, and footwear, to safeguard against UV and infrared radiation and hot molten metal.
- Restrict access for individuals not involved in welding or cutting activities.
- Regularly inspect and maintain welding and cutting tools.

Additional Mitigation Measures

- Excavated soil shall be backfilled promptly after pipe-laying works are completed within the worksites;
- Ensuring that the cap of all soil storage trucks is covered with tarpaulins; controlling lorries loading capacity to avoid spillage;
- Ensuring all machineries, such as excavators and generators are regularly maintained, to minimize smoke and dust exhaust emissions; and
- Fully switching off vehicles and equipment when they are not in use.

Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be reduced from **Minor** to **Neglegible**.

6.4.3 Water Quality and Hydrology

Potential Impacts

Vegetation clearance and excavation works may result in exposed soil which may get carried by surface run-off during rainfall events into downstream waterbodies, resulting in elevated quantities of suspended solids, nutrients, and organic content in surrounding waterbodies. Chemicals such as diesel and cement used and wastewater such as those generated from cement wash, washing of machinery, as well as waste generated on site may be introduced into the environment during accidental spillage or overflow event if not managed properly. This can also be carried by surface run-off into downstream waterbodies, affecting their water quality.

Surface water hydrology can be affected during the construction activities for the WTP expansion facilities. Construction activities can result in compaction of soils and an increase in paved areas from unpaved areas (i.e. earth surface). The subsequent increase in surface runoff may in turn increase the risk of flooding. Additionally, certain activities may encourage soil erosion and increase the sediment loads of nearby streams. Construction activities may also have impacts on groundwater hydrology and quality.

Impacts Evaluation

At the Bau Bang WTP Expanstion facilities location, the site dedicated for this expansion is within the existing WTP complex with concrete drain provided to collect runoff. It is understood from TDM that currently the runoff of wastewater from construction activities with high turbidity and total suspended solid (TSS) is collected to the sludge collection area. In the event of heavy rain, overflow runoff from internal drainage will discharge runoff into the canal at the nearby industrial park. The conversion of existing sludge drying area to paved area when the WTP expansion is constructed will also cause increase in runoff during rain. Other potential concern from the earthworks at this particular site during construction is potential groundwater quality changes due to the sludge being pumped and dried at this

location without any impermeable layer below. The impact **magnitude** of water quality and hydrology is assessed to be **Medium**.

The Bau Bang WTP compound is surrounded by rubber trees plantations. There is no key water bodies identified within the close vicinity of the site during the site visits and from desktop study that are identified as high sensitivity. The **sensitivity** of this impact is assessed to be **Low**. The impacts on water quality and hydrology from the Bau Bang WTP expansion construction is assessed to be **Minor significance.**

As for the proposed 8.0km pipeline construction works, earth drains were identified along the proposed pipeline alignment in very close distance. Any potential pollution from water runoff will enter the earth drain, causing water quality changes. The likelihood of this to happen during construction is high and may cause temporary changes of water quality in the earth drain and subsequently downstream waterbodies. The **magnitude** of this impact along the pipeline is assessed to be **Medium.**

The landuses along the pipeline alignment are mainly farm lands and rubber trees forest. Water from the earth drain may be used for irrigation purposes by the farmers. As the pipeline construction works involces mainly excavation and land filling, the key contamination from construction activities is elevated turbidity in runoff and organic components from site clearance. As such, the **sensitivity** is assessed to be **Low**, resulting in **Minor impact significance.**

Mitigation Measures

It is recommended that the following mitigation measures to be adopted during construction to miminise potential impacts:

- Construction waste and chemicals should be managed properly on site. Waste and chemicals/ diesels etc. should be stored in proper containers with cap, and secondary containment should be provided to all liquid chemical storage used on site;
- Top layers of the existing sludge at the Bau Bang WTP expansion area should be excavated fully an disposed to the third part collector. It is also recommended that the top soil later underneath the sludge is also excavated upto minimum 20cm to ensure all sludge and contaminated soil are removed prior to construction;
- Earthworks to form the final surfaces should be followed up with surface protection and drainage works to prevent erosion caused by rainstorms;
- Concrete drains to be constructed at the perimeter of the WTP expansion facility to cater for increased runoff due to surface changes;
- All drainage facilities and sediment control structures will be inspected on a regular basis and maintained to confirm proper and efficient operation at all times and particularly during rainstorms; and
- Prepare and implement a Surface Water Management Plan including wastewater discharges from construction.

Residual Impacts

With the development and proper implementation of the mitigation measures, the impact levels can be reduced to **Minor**.

6.4.4 Waste Management

Potential Impacts

Construction activities can generate large amounts of waste materials that then need to be disposed of. Construction waste includes waste that is generated during construction activities (such as packaging, or the products of demolition) and materials that are surplus to requirements (due to over-ordering or inaccurate estimating). Typical hazardous and non-hazardous construction waste products can include:

- General waste from site clearance, tree and vegetation clearance etc.;
- Sludge placed on the dedicated land area for the Bau Bang WTP expansion site;
- Insulation materials;
- Concrete, bricks, tiles and ceramics;
- Wood, glass and plastic;
- Bituminous mixtures, coal tar and tar.
- Metallic waste (including rebar, steel, cables and pipes);
- Soil, contaminated soil, stones and dredging spoil;
- Gypsum;
- Cement;
- Paints, thinners, and varnishes;
- Adhesives and sealants;
- Chemical and diesel packaging and containers etc.; and
- Organic waste (from kitchens)

During the construction phase, waste, chemicals, fuel, and oils storage, handling, and disposal, have the potential to cause surface water, soil and groundwater contamination through direct release or from contaminated storm-water runoff. Waste if not managed properly will also cause potential impacts to community health and nuisance.

Impacts Evaluation

The impact from waste streams above will come from the worker rest area (shelter) and construction sites. As per the EIA (draft EIA, TDM 2024), it is expected to have around 100 workers during the peak period of construction phase. The majority of labor force will come from the local people, so worker camp is not required for accommodation overnight. There will only be temporary rest area (shelter) for lunch break during working days. Domestic waste generation is estimated about 58 kg daily and total solid construction waste is limited to 200 tonnes during the whole construction phase, which can be assessed as normal quantities.

The impact will be localised and short-term but high likely, and with the available industry practice mitigation measures in place for waste management, the **magnitude** of the impact is considered to be **Medium**. The receptor **sensitivity** is considered **Small,** given as the exsiting Bau Bang facilities have already developed the waste management system, and there are limited sensitive receptors in the vicinity

of the Bau Bang WTP complex and along the pipeline alignment. The **impact significance** associated with waste generation during the construction is considered **Minor**.

Mitigation Measures

The following in built mitigation measures should be applied for the project as:

- Domestic solid waste to be collected onsite daily and classify at the temporary storage;
- Waste classification as: construction waste, recycable waste and hazardous waste with different storage areas, and disposed of by a registered and licensed waste vendor to approved landfill and / or treatment facility;
- All discharges during construction will be in line with the requirements of local government;
- Sludge on the top layers of the Bau Bang WTP expansion site to be excavated and disposed of by third party waste collector. Excavation should be upto 20cm into the soil layer to ensure all sludge and potential contaminated soil are removed prior to construction;
- Earthworks to form the final surfaces should be followed up with surface protection and drainage works to prevent erosion caused by rainstorms;
- Reusable waste such as nylon, cardboard, cans, and bottles can be used as scrap to continue being recycled. Waste that cannot be recycled will be collected and treated by a licensed unit everyday in accordance with the provisions of Decree 08/2022/ND-CP dated 01 October 2022 of the Government.
- Arrange 2-3 temporary disposal area, each disposal area is from 10-20 m^2, which has a load of about 5-10 m^3 of construction solid waste.
- At the disposal site, a separate container to be collected daily;
- Hazardous waste generated to be collected and separated from other types of solid waste and stored in a temporary hazardous waste warehouse. In the warehouse, arrange 4 orange sealed containers labeled with appropriate hazardous waste codes according to regulations.
- 3-5 mobilised toilets to be installed onsite. The mobilized toilets waste will be collected every 2 weeks.
- A Waste Management Plan to be prepared and implemented for the Project that promotes good international industry practices such as waste avoidance, reduction, segregation and recycling when possible.

Residual Impacts

With the development and proper implementation of the mitigation measures, the impact levels can be reduced to **Minor** to **Negligible**.

6.5 Social Impacts during Construction and Mitigation Measures

6.5.1 Land-use and Livelihoods

Potential Impacts

The following activities can have impacts to livelihoods and displacement during the Construction Phase of the Project.

- Site preparation, excavation and filling works for WTP expansion

- Construction of the proposed 8.3km D1500 pipeline

The Bau Bang WTP expansion land required for the Project is currently owned by TDM and currently used as temporary sludge drying area within the Bau Bang WTP compound. As such, economic and physical displacement impacts are not applicable to the WTP.

With the final alignment of the proposed 8.3km D1500 pipeline from Tru Van Tho pump station to Bau Bang WTP, no household is affected by land acquisition. The following households/ land users will be potentially impacted due to project's temporary land access during construction along the alignment:

Table 6-6: Land-use and Livelihoods impacts by pipeline segments

Pipeline segment	Households/ landuses affected by temporary land access	Type of impacts
Segment 1: 1.6 km in Tru Van Tho commune	10 households affected	No structures will be affected. The affected areas could be summarised as: - About 400 meter-length of Bau Long stream safety corridor (covering bare land, rubber nursery area and about 30 matured rubber trees need to be cut down) - About 75 meter-length of garden land of 1 household with fruit trees (coconut, mango) and vegetables - About 300 meter-length of production land (estimated 5 rubber trees need to be cut down) and 80 meter-length cassava cultivation area
Segment 2: 5 km in Lai Uyen town	11 households [50]whose farms span along the pipeline with short-term crops	The land required for pipeline earthwork and installation along the 110kV transmission line is all owned by EVN and hence no formal land acquisition is required for this section. However, the livelihood impacts may only occur when these areas need to be harvested and temporary unreachable while the transmisttal pipeline construction works are ongoing at that particular section which is short time. Farmers of these short-term crops (mainly cassava) will see a temporary reduction of their income during the construction phase of the project, which is expected that each kilometer length likely to be installed in about 2-4 weeks. Cassava is normally harvested in September annually after 1-year of planting, the losses will be depended on the pipeline construction schedule for this segment. Before the construction the pipeline, TDM will inform the farmers at least 30 days to harvest their crops to minimise their loss on the agricultural products. The affected area traverses along the safety corridor of transmission line, which will affect to some cassava fields (estimated as about 3,000 meter-length) and the entire area are bare land. During the installation of pipeline, about 20 meter-width to both sides will be used as material laydown/stockpile area.
Segment 3:	1 household which the land to be	Pipeline installation will affect rubber trees planted in a length of about 1,000 m. As rubber trees are classified as long-term plant, these trees

[50] Including one household rent affected land from Becamex organization to plant cassava

Pipeline segment	Households/ landuses affected by temporary land access	Type of impacts
1.7 km in Bau Bang industrial zone	acquired were mainly rubber tree cultivation area.	within the earthwork area have to be harvested before starting any site preparation and excavation activities. The potential impacts are predicted as lost of the cultivation area, harvesting before the maturity of plant (which lead to reduction of rubber quantity and quality).

The Project may also bring job opportunities for the local communities. The number of workers to be absorbed during the construction phase of Bau Bang WTP expansion and transimisttal pipeline are expected filled by local residents with the positions such as unskilled and skilled labor. Moreover, the impacts to the local economy from employment and business opportunities arising during Project Construction include local employment and local procurement.

Impact Evaluation

As the land for the WTP is not used local communities, the impact of physical and economic displacement is assessed to be **Negligible** at this location. It is however recommended to identify if any legacy issues with regards to previous land acquisition remain.

Given the uncertainty surrounding the impacts on livelihoods and displacement, it is assumed that there will be physical or economic displacement of some of the planted crops that are present along the pipeline route. In terms of economic displacement and impacts on livelihoods, all impacts are expected to be temporary and short term, and the impact magnitude is assessed to be **Small**. The land affected in Segment 1 are mainly production land/garden land with small amount of plantation to be removed (about 30 matured rubber trees, 2 rubber nursery gardens and several fruit trees to be cut down). Generally, the income of these households are not heavily depended on the these harvesting activities. Other landuses along Segment 2 (about 3,000 meter-length of cassava fields) and Segment 3 (about 1,000 meter-length of rubber trees) that part of agricultural land and crops will be affected by the pipeline construction. Some rubber trees will also need to be cut down for construction works.

Following the socio-economy survey results conducted in May 2024, these owners are in a financially stable position and hence not to be vulnerable to temporary reductions in their income. These households on Segment 2 and 3 of the pipeline who own their businesss with large cultivation areas. The length of cultivation areas to be affected was measured, however the width of area is only estimated as 2.5 – 6 meters. With the 6-meter width used as the worst case scenario, the threshold of 10% production land loss will be considered for three households (the most affected household is owning 1,600 m^2 farm with about 216 m^2 (36 m x 6 m) of production land to be temporary affected, which account for about 13.5% of total cultivation area). For this reason, the receptor sensitivity has been conservatively assessed to be **Medium**. As a result, the impact **significance** can be considered as **Minor**.

The Project is also expected to have a **POSITIVE** impact in terms of employment, procurement, and induced job opportunities, and increase the economic condition of the local people.

Mitigation Measures

Following control measures have been committed by TDM:

- Conduct detailed measurement survey, census, and inventory of losses for all households and business owners to be impacted by the project's temporary land access and access restrictions before the installation of the transmission pipeline. This should assess any physical and economic displacement to be caused by the Project;
- For crops and trees affected along the pipeline: TDM will cooperate with the Construction Contractor to arrange for engagement, notification, negotiation and compensation of potential affected trees to local households and land owners as follows:
    - For trees located within the pipeline alignment or working areas of construction: inform owners to harvest the trees and compensate these trees based on the maturity before trees felling for construction. Notification will be done by TDM at least 30 days prior to construction for the owner to cultivate their crops before construction;
    - For trees in the vicinity of the construction area: to inform farmers on the construction schedule and any potential concerns for their arrangement on the cultivation schedule.
- The temporary land access process will be conducted in line with applicable laws and regulations;
- TDM will aim to avoid the use of extra public land for construction of transmisttal pipeline;
- Together with stakeholder, TDM and their Contractor will identify ways to reduce access restrictions on Segment 1 of pipeline crossing Provincal Road as much as possible;
- There should be no forced eviction for the Project. The Project should put in place a non-tolerance of forced eviction and land grab policy;
- The entitlements shall be identified based on the principles of replacement cost with the aim to at least restore to pre-project status or improve the standard of living.

Following mitigation measures are further recommended to be implemented to ensure the socio-economic impacts are taken care of:

- As TDM developed and issued a Land Acquisition Policy on 11 November 2023, a proper pathway to apply this policy to the expansion project with a clear schedule/timeline for implementation need to be develop.
- To ensure that the stakeholders have access to a grievance mechanism for the communication of any grievances and concerns regarding the project's temporary land access. A project board should be provided along the pipeline construction site providing name of person in charge in TDM, contacts and means of receiving feedback/ complaints from residents and affected households;
- To ensure that the payment of compensation is based on fair market value and disbursal of entitlements for impacted assets, including temporary impacts, are completed prior to the physical use of the land. TDM should work closely with the Contactor on this compensation and monitor Contractor's progress.
- To provide cut-off, which establish the displaced persons who are eligible to receive compensation and assistance from the project.
- The policy on notification before the recovery of agricultural and non-agricultural land at least 90 days and 180 days, respectively, needs to be practiced.

Following mitigation measure will also be implemented to mazimise positive impacts:

- The Contractor should target local employment and provide on the job vocational training, where possible;
- To encourage workers to use local services as much as possible.

Residual Impacts

With the development and proper implementation of the mitigation measures, the impact levels can be reduced to **Negligible**.

6.5.2 Infrastructure and Service

Potential Impacts

The following activities can have impacts to infrastructure service during the Construction Phase of the Project.

- WTP and pipeline construction;
- Transportation of equipment, supplies and workforce;
- Labour, equipment, and services supply;
- Storage, handling and disposal of waste, fuel, chemical, oil, gas.

The above activities will potential impact on the existing infrastructure (roads network, waste stream, population influx, healthcare system, etc.). The most concerned impact to this Project is transportation as the pipeline alignment will cross DT750 (Provincial Road), TVT.39 (about 10 households) and TVT.40 (about 30 households), resulting in temporary traffic restrictions. There will be tempory Closure of existing road at this junction during construction works. As such, it is potentially lead to traffic congestion and affect traffic safety in the area at this junction.

Impact Evaluation

The main construction site of Bau Bang WTP expansion project is within an industrial zone and is a distance away from residential area. The road networks in this industrial zone are wide and well established, therefore the impacts on traffic during the Bau Bang WTP expantion is **Negligible**.

The existing Bau Bang WTP is equipped with toilets and waste storages. Waste stream management could be well-controlled onsite. Therefore the impacts from waste generated during construction phase could be assessed as **Negligible**.

The proposed 8.3km pipeline construction will require additional traffics along the Provincial Road and road closure at the junction that the pipeline crosses at the first 2km segment. The construction works at the affected junction is expected to be in 2-3 weeks. The construction works will be carried out by rolling progress to avoid having various construction site at the same time. As such, the number of truck trips daily will be insignificant and spread thoughout the 12 months of construction. However, road closure at the Provincial Road junction if not planned properly will cause potential significant inconvenience to road users as well as traffic safety hazard. As such, the impact **magnitude** is assessed as **Medium.** It was observed during the site visit that the traffic flow is realtively low along this road, and there are limited residential houses along the road. In addition, the road at this junction was observed to be wide that

traffic diversion temporary during pipe laying is feasible. As such, the receptor is **Low Sensitivity**. The **impact significance** during the construction is therefore assessed to be **Minor**.

Mitigation Measures

The controls to be implemented for the Project are suggested as the following:

- TDM should consult local transportation authorities on the road closure plan and traffic diversion/ Traffic Management Plan (TMP) especially for the junction crossing Provincial Road of the pipeline. Temporary traffic diversion plan utilizing the available road reserve should be planned properly, and the construction work at this junction should be planned in such the way that only 1 lane is closed during conostruction. Approved plan is required to be strictly complied with during construction;
- TDM should carry out public consultation to all households along this junction at least 1 week in advance before the construction starts;
- Schedule construction traffic to avoid peak traffic periods;
- Contractor is to spray water regularly at this junction during construction to ensure dust is controlled to prevent any visibility obstruction to traffics;
- Site reinstatement and rehabilitation will be performed including repairing any damage caused as part of the construction activities and reinstating existing access roads when needed;
- Record complaints under the Grievance Mechanism process and follow up by identifying the causes and responding appropriately within 48 hours of receiving the complaint to mitigate the disturbance.

Residual Impacts

Based on the successful implementation of these mitigation measures, it is anticipated that the residual impact levels can be reduced from **Minor** to **Negligible**.

6.5.3 Occupational Health and Safety

Potential Impacts

Throughout the construction period, construction activities will impost several potential occupational health and safety risk and hazards such as:

- Traffic incident/ accident;
- Working at height;
- Moving objects;
- Slips, trips, and falls;
- Heat stroke during summer period;
- Hand arm vibration syndrome;
- Material and manual handling;
- Collapsing trenches;
- Electricity;

- Exhaustion due to long working hours;
- Confined spaces;
- Airborne fibres, materials, organic and inorganic dust and gas.

Impact Evaluation

The construction of WTP, the pipeline and associated facilities involves high-risk activities with the potential for accidents that may result in injuries and potential fatalities as well as lost man-hours. The chances of this risk to happen is daily in every activity. Employees of local contractors and those in the supply chain may not have international standard training in occupational health and safety, covering issues such as use of personal protective equipment, and in general, there is poor enforcement of occupational health and safety regulations in Vietnam. The impact **magnitude** is assessed to be **Medium** fo the scale of the Project. Workers are exposed to the risk at all time during the 12 months of construction, and with the common practice of health and safety for construction works in Vietnam, PPE and some basic health and safety measures are in place which will eliminate the risks. The **sensitivity** is hence assessed to be **Medium,** resulting in **Moderate** impact significance.

Mitigation Measures

It is understood that TDM has occupational, health and safety policy at corporate level. However, the policy has not been adopted wisely for their projects. It is recommended that specific requirements on health and safety to be included in the tender specifications as one of the key requirements to select contractors, and specific scoring should be given to tender evaluation.

In addition, following mitigation measures should be implemented to minimize OHS impacts:

- An Occupational Health and Safety Plan should be prepared by the Contractor covering:
  - Site management plan including hoarding and barrier provision to construction site with no public access, clear signs and signals e.g. should be provided at active construction site for authorized personnel only;
  - Provision of appropriate and sufficient PPEs to workers;
  - Prohibition of drinking or the use of any drugs during work hours;
  - Provision of first aid kits and personnel, and emergency unit on site;
  - Provide relevant training to ensure staff are aware of the Health and Safety protocol and requirements of the Project.
- The project will comply fully Vietnamese labour laws
- All staff will have regular medical check-ups when required;
- Having buddy system to ensure at least 2 workers/ persons are present at construction area especially for works with high risk;
- Providing sufficient water and refreshment to workers especially during extreme weather conditions. Available shelter should be provided for workers to rest during lunch time or break time;

- Create and implement an environmental management system for the project. It will include mandatory health and safety training courses for all workers and contractors, including handling of hazardous material;
- To require all sub-contractors and suppliers to comply with OHS requirements at site if they enter the site at any time;
- Provide sufficient PPEs for all personnel, subcontractors and suppliers entering the construction sites;
- Monitor, record and report all Health, Safety and Environmental (HSE) matters as per good international industry practice shall be done on a monthly basis; and
- The EHS officer to carry out regular monitoring of OHS on site during construction period and recommend improment where relevant.
- Where accommodation is provided for workers, construction contractor will prepare a worker accommodation plan specific requirements on the quality and management of the accommodation and provision of basic services satisfactory with ADB SPS[51], e.g., adequate sanitary facility, non-discrimination and equal opportunity, including prevention of SEAH[52] or not restrict their freedom of movement or of association.

Residual Impacts

With the development and proper implementation of the mitigation measures, the impact levels can be reduced from **Moderate** to **Minor**.

6.5.4 Community Health and Safety

Potential Impacts

Community health and safety impacts resulting from the influx of the construction workforce and noise from Project activities have been identified as the main social concerns in many industrial projects. This section provides an assessment of such impacts. Based on information from the local EIA report, the Project is likely to employ approximately 100 workers at peak time during the Construction Phase. The proportion of local workforce is unknown at the time of this assessment, as such the following assessment will be for the worst case when all 100 workers are from other areas.

The potential interaction between the workforce and local communities poses the risk of conflicts and security issues including fighting due to heavy drinking and gambling. Another risk which is likely to occur due to the influx is the transmission of communicable diseases such as Tuberculosis, Hepatitis A, Hepatitis B, HIV/AIDS and other sexually transmitted diseases between migrant workers and local people which could threaten the health of the local communities.

Noise and air pollution will be generated from construction activities such as land clearance, earth works, excavation, mobilizing of equipment/ machinery, and transportation of materials and workforce influx, civil works for the project. Moreover, construction activities can generate waste materials such as packaging, demolition waste and materials that are surplus to requirements (due to over-ordering or inaccurate estimating). The presence of the influx in local area could be a pressure to these infrastructure

[51] https://www.adb.org/sites/default/files/institutional-document/915711/environmental-and-social-framework-w-paper.pdf
[52] sexual exploitation, abuse, and harassment

and services. Moreover, increasing demand of using health care services and buying foods and commodities will be the predictable consequence of this impact.

Road occupation during construction especially at the segment to undercross the Provincial Road will hinder risk of traffic incident/ accident. In addition, additional traffics during construction due to material, waste, machinery and workers transportation will make existing roads to be busier. Dust generated during construction will also cause potential risk of visibility reduction along the roads. These will cause potential incident/accident to road users and residents in the vicinity, especially along the first segment of the pipeline starting from the pumping station and crossing the Provincial Road.

Impact Evaluation

It is understood that the construction phase of the project will be lasted for about 12 – 24 months, the impact could be assessed as short term and temporary. Moreover, the impact would be limited to local communities or sectors related to the immigrant of external worker resources. The **magnitude** of impact caused by labor influx and potential traffic impacts during the construction phase could be estimated as **Medium** considering the significant number of workers, risks of infectious diseases and general social conflicts between local communities and immigrants, as well as the road occupation during construction road that partial road will be closed. Given the presence of local communities with the good condition of the local infrastructure and public services including waste collection services within local communities, as well as the low traffic on the existing roads, the **sensitivity** is considered **Low,** resulting in **Minor impact significance**.

Mitigation measures

The following mitigation measures should be applied to Bau Bang expansion projects:

- Coordinating with local authorities and relevant agencies to organize programs such as education and awareness raising for workers;
- Providing training to local people for them to satisfy the recruitment requirements of the Project to increase local employment opportunities;
- Coordinating with local authorities to manage temporary resident registration for migrant workers and to monitor social security in the area where migrant workers will be accommodated;
- Construction Contractor should conduct compulsory medical examinations (i.e., annual health check-ups) for Project workers including contractors as required by national regulations to ensure they are fit for work and to monitor the prevalence of communicable diseases;
- Construction Contractor should establish an onsite health clinic for Project workers involved in construction;
- Project Owner and Construction Contractor should maximise local employment;
- Construction Contractor should implement a “zero tolerance” policy towards inappropriate behavior from and amongst the workforce;
- Construction Contractor should develop a Project Code of Conduct;
- Construction Contractor should share the Project Code of Conduct with workers of contractors and requesting their compliance;

- Construction Contractor should develop and implement regulations/policies for non-local workers staying in construction camps regarding behaviour towards local communities and restricting hours for going out;
- All construction equipment will be fitted with well-maintained mufflers and noise control devices.
- Portable equipment producing excessive noise will be strategically located away from residential areas and enclosed within sound-dampening structures whenever possible.
- Idling of equipment will be strictly limited, and engines will be shut down when not in use.
- Construction traffic will be routed to minimize disruption to residential neighborhoods.
- Work hours will be restricted to 7:30 am - 5 pm, with noisy activities avoided during typical post-lunch quiet hours near the DT750 Provincial Road junction.
- Efforts will be made to stagger the operation of noisy equipment and activities to reduce overall noise levels.
- Water spraying will be conducted at least twice daily in areas prone to dust generation.
- Main access roads will be regularly cleaned to prevent dust accumulation.
- A 3-meter-high metal fence will be installed around the perimeter of the WTP expansion site to contain dust.
- All material transport vehicles will adhere to relevant regulations, including weight restrictions to avoid overloading.
- A comprehensive Traffic Management Plan (TMP) will be developed in consultation with local transportation authorities to address road Closures, detours, and potential traffic impacts, particularly at the DT750 Provincial Road junction where the pipeline will cross.
- TDM should implement the SEP. Community Liaison Officers of the Project should assign and deliver induction training to provide guidance on requirements for culturally appropriate behaviours and an overview of the risks to migrant staff and workers. The training will include key cultural sensitivity awareness topics/programs to ensure workers including security staff do not unintentionally offend the local community;
- TDM should establish and disclose a grievance mechanism to community.

Residual impacts

With the development and proper implementation of the mitigation measures, the impact levels can be reduced from **Minor to Negligible**.

6.5.5 Cutural Heritage

Potenitial impact

As observed during the site visits, no physical or cultural resources identified within the vicinity of the Bau Bang WTP compound and along the proposed 8.3km alignment. However there will be potential to uncover a heritage item/site referred to archaeological resources (which can be refered to the definition of Physical Cultural Resources in Safeguard Policy Statement as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance). They may be located in both urban or rural

settings and may be above or below ground or under water and their cultural interest may be at the local, provincial, national, or international level.

Impact evaluation

The vicinity of the Bau Bang project (including both WTP and pipeline components) are expected to be located in a remote areas. The stakeholder engagement and consultation with local authorities and community representatives during the site visit in May 2024 inform that no declared and recorded archaeological sites or archaeological potential areas are identified from both records and field investigations within the Project area. Therefore, the **impact signficance** can be considered as **Negligible**.

Mitigation measures

Based on the document review, TDM issued a Chance Find Procedure with document No. QT01/CPNTDM dated 11 November 2023, which outlines what will need to be considered if previously unknown heritage resources, particularly archaeological resources, are encountered during project implementation. This procedure is developed for the construction phase of the Projects to: (i) Protect tangible cultural heritage from adverse impacts of the Project activities; and (ii) Promote awareness of and appreciation for tangible cultural heritage and support its preservation. This document is sufficient to reduce the potential adverse impact causing by the construction phase of Bau Bang WTP expansion project.

6.6 Environmental Impacts during Operation and Mitigation Measures

6.6.1 Waste and Sludge Management

Potential Impacts

The waste generated during the operation phase will predominately comprise of the sludge from the WTP process, as well as general waste from office and hazardous waste such as light bulbs, lubricants, ink, electronic circuit boards, batteries, chemical rags, chemical containers, etc. Waste generated if not managed properly will cause potential impacts to health risks to operator and groundwater and soil quality.

Impact Assessment

Slurry sludge is generated with large quantity from the treatment process will be pumped into the concrete sludge basins as per design, dried by letting the the sludge to settle down in the containment and evaporated after water will be overflowed back to the WTP for treatment. The dried sludge will be collected by BIWASE waste collector for final treatment and disposal.

It is understood that no additional sludge containment is constructed for the expansion project, as the existing sludge basins have sufficient capacity to cater for the expansion capacity. However, it was observed during the site visit that the sludge basins are currently under utilized while sludge is pumped to the elevated land allocated for the WTP expansion for drying, while slurry water is overflowed to a nearby earth pond. Both the said temporary sludge drying area and earth pond do not have any impermeable layer underneath to prevent infiltration into the groundwater and soil, which does not comply with QCVN 07-1:2016/BXD: National Technical Regulation for Technical Infrastructure Works Water Supply.

When the WTP expansion is in operation, if sludge is not managed properly and existing operation conditions are not improved, sludge handling will cause potential impacts to underneath soil and groundwater. Besides sludge, other solid and hazardous waste generated from the WTP operation if not

managed properly will also potentially cause health risks to workers. The capacity of the existing sludge drying field (no expansion required) is 1,215 m^3 (1,215 m^2 x 1 m depth). With the expansion WTP in operation, total sludge generation from both existing and expansion plants is estimated to be approximately 13 m^3/day, so the existing sludge drying bed will be filled up to its max storage capacity in two months. The **magnitude** of the impact is assessed to be **Medium**, as the operation of the WTP expansion will be at least another 20 years and will be further expanded, causing detectable change and result in permanent change of groundwater and soil conditions.

Sludge from WTP is not considered to be toxic or hazardous. Under Vietnamese Environmental Law, this sludge is not classified as hazardous waste. Underground water in Binh Duong is not used for households or any sensitive purposes. In addition, this impact can be easily mitigated by fully compliance with the QCVN 07-1:2016/BXD: National Technical Regulation for Technical Infrastructure Works Water Supply by fully utilising the existing sludge basins to their max capacity and discharge the dried sludge more frequently to BIWASE waste contractor. Similarly to hazardous waste generated from the existing Bau Bang WTP, the facility has separated area for hazardous and solid waste storage which need to be improved to meet Vietnamese Environmetnal Law on hazardous waste storage. TDM is currently having contract with BIWASE to collect solid and hazardous waste from Bau Bang WTP, which will include waste collection for the expansion facility. The collected sludge from BIWASE will be recycled properly after treatment as one of the raw material for construction brick manufacturing[53]. As such, the receptor in this case is considered to have some capacity to absorb the changes and there are reasonable opportunities for mitigation, and the **sensitivity** of this impact is therefore **Low**, resulting in **Minor impact significance**.

Mitigation Measures

The following mitigation measures should be applied to Bau Bang expansion projects:

- Existing sludge on the area dedicated for future expansion should be excavated fully and collected by BIWASE for treatment. The excavation should cover at least 20cm underneath the sludge to ensure all contaminated soil is removed before construction;
- The existing earth pond used within existing Bau Bang WTP is not included in the approved design drawings and does not comply with law and regulation. If TDM would like to continue to use this earth pond as back up for overflow water from sludge basis in case of heavy rain, impermeable should be laid at the bottom of the pond;
- Sludge basins should be fully utilized during the operation, and sludge collection should be carried out regularly (recommend to be collected monthly based on the treatment capacity) to ensure sludge basis has capacity for coming sludge in the next batch of treatment;
- Hazardous waste storage area should be improved to meet law and regulation. Signage of "hazardous waste storage" should be provided. Hazardous waste should be segregated and labeled within the storage area. Hazardous waste storage area should be accessible by authorized personnel only;
- Per the local EIA sludge will be collected by licensed third party waste collector for proper treatment process;
- TDM or their contractors to conduct annually monitoring sludge quality at the sludge drying beds following QCVN 50:2013 –National Technical Regulation on Hazardous Threshold for Sludges from Water Treatment Process to ensure sludges quality is not classified as hazardous waste

[53] https://biwase.com.vn/tin-tuc/tin-tuc-hoat-dong/hoat-dong-3rs-tai-khu-lien-hop-xu-ly-chat-thai-nam-binh-duong

- A Waste and Sludge Management Plan prepared should include all activities for the expansion and implemented for the Project that promotes good international industry practices such as waste avoidance, reduction, segregation and recycling when possible;
- Monthly site audits by TDM E&S personnel will be carried out to verify the project compliance with the mitigation measures outlined in the ESMP.

Residual Impacts

With the development and proper implementation of the mitigation measures, the impact levels can be reduced from **Minor to Negligible**.

6.6.2 Chemical Usage and Storage

Potential Impacts

Chemicals used at Bau Bang WTP expansion include (1) chemicals used in the water treatment process and (2) diesel. Bau Bang expansion as a typical WTP, the coagulation and flocculation stage requires significant amount of lime and Poly Aluminium Chloride (PAC). Chlorine will also be dosed at a industrial scale of disinfection process while diesel will be prepared for generators usage.

Lime and PAC can be well-handled because these chemicals are quite popular in water treatment industry with best practices to be applied, which should minimize the potential impacts. However, there would be use of diesel across the site during commissioning and operation phase of the Project for operation & maintenance (O&M) services as back-up fuel resource for generator, which is unlikely to be used frequently. Diesel is stored onsite at both pump station and WTP in two number of $2m^3$ tanks for each component. This storage area is well placed within concrete shelter area with fences, safety signs and leakage response kits. The surrounding areas around these diesel storages are also paved with concrete. According to EIA report, at this scale of the diesel storage onsite, TDM will follow the guideline of Law on Chemicals 2007 and Decree 113/2017/ND-CP on fire safety of flammable chemical, but no permit will be required. If there is any risk of fuel spill on-site, wastewater and used spill kits will be collected and disposed off as hazardous waste, so the risk of contamination to soil or water is unlikely. Large-scale fire could result in injuries to staff within Bau Bang WTP compound, or in the worst-case fatalities, as well as fire to nearby buildings/ facilities. Fire accidents might lead to uncontrollable wildfire, loss of crops and habitat given the environment settings at the Project area.

Chlorine is listed as a hazardous and toxic chemical, which need a specific Management Plan for Prevention, Response for Emergency Incidents before starting the operation phase following Article 38 of the Law on Chemical 06/2007/QH12 and Clause 1 Article 20 Decree No. 113/2017/ND-CP dated 09 October 2017. Despite the existing neutralization system has been installed for 30,000 m^3/day capcity, a separated Chlorine house with an additional neutralization system will be installed for the Bau Bang expansion project at the capacity of 100,000 m^3/day. From the site observation for existing facilities, emergency response kits and safety tools such as gloves, safe shower and warning signs are fully equipped. TDM has not developed any specific management plan to handle, storage and usage of Chlorine. Chlorine leakage need to be assessed seriously to prevent any potential risks during the plant's long-term operation to staff.

Impacts Evaluation

As observed during the site visit, there are around 15 households scattered Bau Bang WTP area in Cay San hamlet, Lai Uyen commune scattered around with a distance of more than 300m from the Bau Bang WTP

compound's boundary which is well compliance with TCXD 33:2006/BXD – National Standard for Water Supply – Distribution System and Facilities Design, Article 11 Clause 25 that the distance between the treatment facilities using Chlorine and the residential areas should be at least 300m. Bau Bang WTP compound, besides the footprint of the WTP and associated facilities, include a large area of rubber trees belong to TDM. The vicinity of Bau Bang WTP compound are also surrounted by rubber tree forest. As such, the risk of potential impacts from fire or chemical leak is low. As such, the **magnitude** of the impact is assessed to be **Small**. Considering the impact consequence of chemical leakage and other unplanned incidents may cause serious injury or fatality, the sensitivity of this impact is assessed to be High, as both workers and communities has no capacity to deal with the incident if happened. The impact is therefore assessed to be **Moderate significance**.

Mitigation Measures

The suggested mitigation measures to be implemented during the Operational Phase are:

- Implement good site management practices to ensure that the products are properly stored on site and in areas where spills will not easily reach the environment (e.g. in paved areas with secondary containment);
- The Project should implement the SEP and a robust stakeholder engagement programme on emergency response including on chlorine leakage;
- Implement routine inspection and maintenance procedures (in line with international best practice) for any hazardous substances' storage;
- Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed or toxic chemicals;
- Develop Emergency Preparedness and Response Plan with forest fire protection and monitor contractors to ensure consistent implementation;
- Ensure fire respond facilities are always available and in working conditions to cope with any emergency. Fire respond facilities should be included in the routing EHS audit by TDM EHS personnel;
- Conduct regular safety and fire prevention & fire drills;
- Regularly monitor Chlorine concentration surrounding storage areas;
- Develop a specific Chlorine Management Plan which details the procedures to handle, storage and usage of Chlorine before starting the operation phase following Article 38 of the Law on Chemical 06/2007/QH12 and Clause 1 Article 20 Decree No. 113/2017/ND-CP dated 09 October 2017;
- TDM to follow the guideline of Law on Chemicals 2007 and Decree 113/2017/ND-CP on fire safety of flammable chemical;
- Update the Emergency Response Plan with an Evacuation/Rescue Plan to escape on Chlorine leakage incidents;
- Follow technical standards on buffer distance (TCXDVN 33:2006 Water Supply Distribution System and Facilities Standard) which recommends a buffer distance of 300m from chlorine storage faciliotiesto residential households.

- Conduct regular training on Emergency Response for Chlorine Gas Leakage and Chemical Spill incidents;
- Disclose Emergency Response Plan to the communities about the Chlorine Leakage incidents.

Residual Impacts

With the development and proper implementation of the mitigation measures, the impact levels can be reduced to **Moderate** to **Minor**.

6.6.3 Aquatic Life

As previously described in Section 5.1 (Biodiversity) and results of CH screening, which was supported by a baseline survey and sampling for aquatic life at the intake point and vicinity (draft EIA, TDM, October 2023); the aquatic habitat at the project site has a relatively low biodiversity value and no rare or endangered species were found during surveys.

However, with the potential presence of *Poropuntius deauratus* (one of the globally Endangered fish triggering Vinh Cuu Extension KBA) in the catchment that feeds into the Phuoc Hoa- Dau Tieng canal, this fish species might be present along the canal and might follow the intake facility to enter the reservoir at the pumping station.

Potential Impacts

The expansion project will require a continuous volume of 130,000 m³/d of water from the Phuoc Hoa-Dau Tieng Canal (the currently approved extraction permission is 60,000 m³/d). The vision for the project until 2050 is to reach 350,000 m³/d. The designed flow capacity of the canal is 75 m^3/s[54], therefore the expansion extraction capacity to 130,000 m^3/d (or 1.5m^3/s) is equivalent to only approximately 2% of the designed flow and would not create any significant change in the downstream canal's water level and its local hydrological scheme.

However, while water intake does not introduce any contaminants into the canal, water extraction directly from this canal could potentially impact the biodiversity residing near the water intake point. The withdrawal may create a turbulent flow that redistributes riverbed sediments into the water column as well as impinge large aquatic species into the intake structure or entrain smaller fish, eggs, and larvae. Particularly small or juvenile fishes are at risk of being drawn into intakes. Moreover, this could affect fish migrations as fish generally follow currents which may lead them towards the intake.

Therefore threatened freshwater fauna if there is, particualy fish, are most susceptible to the adverse impacts caused by the intake of the pumping station, in which Yellow Tail Brook Barb (as **Error! Reference s ource not found.**provided previously in Section 5.11.3,) is the species of concern that potentially present at the intake (**Error! Reference source not found.** and Figure 6-1).

According to Fishbase[55], max length and weight of the EN fish Poropuntius deauratus is 17 cm and 55.32 g, respectively, which is relatively small and may be at risk of being drawn into intakes. Especially, as reported during the scoping site visit (October 2023), no screening structures were observed at the intake point.

[54] http://www.vncold.vn/Web/Content.aspx?distid=163

[55] https://fishbase.mnhn.fr/summary/27122#:~:text=Caudal%20fin%20very%20pale%20yellow,36949). [Online accessed 3-July-2024]

Table 6-7: IUCN Threatened Fish Species Potentially Susceptible to Impacts Caused by Pumping Station Intake

Common Name	Scientific Name	IUCN Category	IUCN Criteria	Status
Yellow Tail Brook Barb	*Poropuntius deauratus*	EN	A2ac	Full Migrant

Figure 6-1: EN fish *Poropuntius deauratus (*Picture by Warren, T. on Fishbase)

Impact Evaluation

The receptor of this impact is the Phuoc Hoa Dau Tieng canal and aquatic species, putting the receptor importance at **Medium**. Currently there is no available facilities available at the intake to prevent fish entering the intake structure, passing through the pipelines and subsequently entering the reservoir. Fish lavae continues to be pumped into the WTP. As observed during the site visit, fishes were found in both the reservoir at the pumping station and within the tanks of the existing Bau Bang WTP. As recommended by IFC EHS Guidelines on Water Consumption and Aquatic Habitat Alteration[56] recommended considering the availability and use of water resources locally and the ecological characteristics, specifically:

- Intake volume: Given the significance of the Phuoc Hoa – Dau Tieng flow rate, the intake volume of expansion project (130,000 m^3/d) is not creating any issues to the availability and the authority planned for water resources;
- Intake flow rate: IFC EHS Guideline recommended reduce the maximum through-screen design intake velocity to below 0.5 ft/s or 0.15 m/s. However, design of the intake structure is not available and intake velocity is unclear.

Considering the likelihood of entrapment incidents, the **magnitude** of impact could be assessed as **Medium**, as it may lead to reduction of fish population along the cannal. As the operation will be long term, this impact is considered permanent and may lead to significant impacts upon this species. In the absence of mitigation measures, the significance of this impact therefore has been evaluated as **Moderate.**

[56] IFC EHS Guidelines for Thermal Power Plant regarding water consumption and aquatic habitat alteration (https://www.ifc.org/content/dam/ifc/doc/2000/2008-thermal-power-ehs-guidelines-en.pdf)

Additional Mitigation Measures

As the intake structure is not required to be upgraded as part of the Bau Bang WTP expansion plan, TDM has no plan to upgrade the structure. The following measures will, however, be adopted to minimise potential impact on aquatic fauna, particularly the Yellow Tail Brook Barb fish species that potentially present at along the Phuoc Hoa- Dau Tieng cannal:

- Depending on type and design of the intake structure, installing a trash rack and fine mesh (as small as possible for practical operation, with a recommended 5mm mesh size) is recommended at the inlet to prevent trashes and small fishes from entering the intake facility.
- Currently, design of the intake structure and measured intake velocity is not reported; however, it is recommended to keep the maximum through-screen design intake velocity to below 0.15m/s by redesigning the screening structure or other means to reduce the flow as low as possible to minimize the impact on aquatic life.
- Implement visual inspection of fish kill at intake point and fish presence in the reservoir or tanks of the WTP as part of the daily O&M activities checklist and prepare appropriate response when unusual visuals are detected.

Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be reduced from **Moderate** to **Minor.**

6.7 Social Impacts during Operation and Mitigation Measures

6.7.1 Occupational Health and Safety

Potential Impacts

The following activities can have impacts to occupational health and safety during the Operational Phase of the Project.

- Operation of the WTP expansion;
- Maintenance of pipeline and other associated facilities.

The expected impacts due to the maintenance of WTP during operation will be similar to those discussed in the construction phase with less risks linked to spread of disease as the number of employee required for operation will be much lesser than number of workers needed during construction phase. The occupational hazard and safety issues during operations include:

- Exposure to biological agents such as bacteria, protozoa, viruses, helminths, and fungi. The main routes of exposure are hand-to-mouth contact. Inhalation of a suspension of particles (aerosols) is a fewer common means of exposure but may occur with any activities relevant to sludge collection and transportation. This may occur near sludge outlets, seepage receiving chamber, at the sludge drying beds and when hosing down wet wells, pipes, and tanks;
- Asphyxiation due to lack of oxygen when working in confined spaces;
- Risk of exposure to toxic gases such as chlorine when working in confined spaces or chlorine leak
- Risk of falls into chemical mixing systems (especically lime);
- Risk of slips, trips, and falls on wet floors;
- Risk of falls into treatment tanks.

Impact Evaluation

The receptors are the workforce at the site who, with existing controls in place, are expected to be of **Low** sensitivity, as TDM has been engaging and will continue to engage experience staff and provide required PPEs required during operation. The project involves general operation and maintenance of the pipeline and WTP and as such, the impact magnitude is expected to be **Small**. Therefore, the **significance** of impacts to occupational health and safety is considered to be **Minor**.

Mitigation Measures

The controls that are committed to be implemented for the Project will include the following:

- An Occupational Health and Safety Plan will be prepared and implemented covering:
  - Appropriate PPEs for each task such as: general operation activities (helmet, protective SMthing, mask, safety boots, gloves); working with pumps (ear plugs), working with Chlorine (eyes protection glasses, respirator) etc.;
  - Clear signs and signals e.g., safety hat required, no entry due to restriction areas (for safety and security reason), etc.;
  - Prohibition of drinking or the use of any drugs during work hours;
  - Provision of first aid kits and personnel, and emergency unit on site;
  - Provision of relevant training to ensure staff are aware of the Health and Safety protocol and requirements of the Project.
- The project will comply with Vietnamese labour laws as per TDM OHS compliance;
- All staff will have regular medical check-ups where required;
- Conduct mandatory health and safety training for all workers and contractors, including handling of hazardous material. This training will take place prior to work starting on operation;
- Provide workers with the required and appropriate personal protective equipment (PPE) such as eye protection, ear protection, work gloves and protective boots to undertake site activities;
- All staffs have to be able to swim;
- Monthly site audits will be carried out to verify the project compliance with the mitigation measures outlined in the ESMP.

It is also recommended that, all the proposed rectification plan for TDM corporate and existing Bau Bang WTP recommended in the ESCA report to be implemented wisely in all operation activities of TDM, including these expansion facilities.

Residual impacts

Based on the successful implementation of these mitigation measures, it is anticipated that the residual impact levels can be reduced from Minor to Negligible.

6.7.2 Community Health and Safety

Potential Impacts

The activities can generate impacts to community health and safety during the Operational Phase of the Project including operation and maintainance activities of pipeline network and WTP. Impacts to

community health and safety during operation include from transportation of workers, security issues and waste management. These will be similar, but to a smaller extent, as impacts during construction phase. Another potential impact to community health is risk of chlorine leak during operation of the WTP.

Impact Evaluation

In terms of the work force, the operation would be long-term (as the WTP and the associated facilities will be operated for decades) with limited number of workers to be employed (expect to be much more lower comparing to the construction phase). As such, impact magnitude is Medium. Receptor sensitivity is expected to be Low given the very limited residential households to be presented in the area, both along the pipeline and the WTP compound. In addition, there is no household located within 300m from the WTP compound. The few houses identified are more than 300m away, and separated from the Bau Bang WTP compound by rubber trees forest so any leak of chlorine will be absorbed by rubber trees before dispersing to households. The impact significance for community health and safety are therefore expected to be Minor.

Mitigation Measures

The mitigation, management, and monitoring measures are suggested as follows:

- Develop and implement a Workforce Code of Conduct which will be adhered to by all Contractors and employees;
- A Waste Management Plan should be developed to ensure adequate and legally acceptable control and management of transport and disposal of all wastes on and off site;
- The Project will ensure that there is adequate fencing around the project site to minimise the risk of trespass. Fencing will be checked periodically to ensure that it is in good condition and to look for any signs of entry;
- A Stakeholder Engagement Plan should be developed to ensure local communities are kept updated on Project activities, be aware of the risks, warning system and emergency response from chlorine leak;

Residual Impacts

Based on the successful implementation of these mitigation measures, it is anticipated that the residual impact levels can be reduced from **Minor** to **Negligible**.

7. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

7.1 Engagement during EIA process

During the local EIA preparation process, public consultation is required to be carried out as regulated in the Decree No. 18/2015/ND-CP. The regulation only requires a limited number of stakeholders that must be consulted. For this Project, these would be the commune level People's Committee and Fatherland Front Committee, which are considered the representatives of local authority and local affected community, respectively. Large-scale public consultation that includes face-to-face meetings with affected communities can be requested, upon decision of the commune level People's Committee. Additional consultation will also need to be reach out to relevant stakeholders. For Bau Bang WTP expansion projects, it was defined as (1) Southern Irrigation Management Company (authority managing the water intake of the project from Phuoc Hoa – Dau Tieng canal) and (2) Binh Duong Electricity Company (authority managing the land under the 110 kV transmission line).

Commonly, the Project Owner is required to send a consultation request letter along with a written summary of project information, and potential environmental and social impacts associated with mitigation measures proposed to relevant stakeholders. Within 15 working days upon receiving a request from the Project Owner, contacted stakeholders shall provide their responses in writing. The forms of public consultation request and stakeholder's response are provided in Appendices of Circular No. 02/2022/TT-BTNMT.

The engagement effort during the EIA process of the Project is summarized as follows:

- On 22 February 2024, TDM submitted the draft EIA to Tru Van Tho CPC and Fatherland Front Committee of Tru Van Tho commune and Southern Irrigation Exploitation Company for consultation on potential environmental and social impacts identified and mitigation measures recommended in the EIA report.
- On 26 March 2024, TDM received official responses from Tru Van Tho CPC and Fatherland Front Committee of Tru Van Tho commune highlighting the following: reducing air pollution and dust caused by material transportation; managing workers during construction; prioritising recruitment of local people for construction work; ensuring local security, occupational health and safety, and fire prevention during construction; and implementation a compensation plan for AHs.
- On 29 March 2024, TDM organised a public consultation session in Cay San hamlet's office, Lai Uyen town with the participation of Lai Uyen TPC representatives and 15 local households. The purpose was to inform the project information, present the project's potential impacts and recommended mitigation measures, and gather public opinions on the project implementation. Overall, the local authorities and communities showed their support for the project development and recommended the installation of signage boards, reduction of air pollution and dust from material transportation, and proper treatment of waste and wastewater during construction.
- On 5 April 2024, TDM received a official response from Binh Duong Electricity Company regarding the project's EIA report. The Company committed to ensuring a stable electricity supply for the project as specified in the EIA.
- On 5 April 2024, TDM also received an official response from Southern Irrigation Company on the draft EIA. Generally, the Company agreed with the content of the draft EIA and suggested to

increase the capacity of exisiting Intermediate reservoir in pump station from 60,000 m3 to 350,000 m3 to ensure the minimum storage capacity of raw water for at least one day in case the water source from Phuoc Hoa – Dau Tieng temporary cut-off for repair and maintenance.

- On 9-10 May 2024, TDM and their EIA consultant, together with ESC, organized two public consultation sessions as part of the requirements on the local EIA process. The meetings were held at the community house of Hamlet 2 in Tru Van Tho commune and at Lai Uyen TPC's office, with participation of local authorities, TDM representatives, EIA consultants, ESC personnels, and affected residential communities in the project areas. Generally, the community was supportive to the project due to its positive impacts on supplying more water, and recommended that the proposed environmental and social mitigation measures to be implemented to reduced negative impacts. All the opinions from these public consultations will be recorded in the final EIA report.

Upto the time of writing this report, the results of public consultation during EIA process has not been finalized by local EIA consultant and TDM. The local EIA report is still under review of Binh Duong DONRE before submitting to MONRE for final approval.

7.2 Engagement during IESE process

A core element of IESE engagement activities is to gain an understanding of potential key stakeholders and engage with them in a meaningful manner that allows them to participate in and provide key concerns they may have in relation to Project development freely and openly. As part of the IESE report preparation, stakeholder engagement was undertaken by ESC on 09 and 10 May 2024. The public consultation meeting recorded the participation of 25 households: 11 from Lai Uyen townlet and 14 from Tru Van Tho commune. Of these, 23 attended the meeting in person, while 2 from Tru Van Tho commune were consulted at their houses. Additionally, 6 authority representatives were consulted, three from Lai Uyen TPC and three from Tru Van Tho CPC. In addition to the collation of inputs received from various stakeholders during engagement activities. The objectives of the engagement during IESE process were to:

- Officially disclosure the project information including project objectives, key activities and construction schedule to the local communities, key impacts and mitigations during construction and operation phases
- Undertake engagement in a meaningful manner that allows for the informed participation of all stakeholders in the early stages of risk and impact identification and assessment;
- Gain initial understanding on the social-economic conditions of local communities to have initial risk identification and assessment;
- Leverage the established inclusive and continuous processes to attain and collate direct input from various stakeholders that can influence both Project design and development; and
- Establish a basic framework and communication protocol which commits to ongoing stakeholder engagement based upon the principles of providing free, prior, and transparent access to Project information.

The list of stakeholders involved in the meetings and discussion topics are provided in Table 7-1 below.

Table 7-1: Stakeholders involved in during site visit

Stakeholder	No. of persons	Participants	Engagement Topics
TDM project staffs	2	• Mr Nguyen Van Tan – Deputy General Director of TDM • Mr Pham Tien Hung – project officer	• Updates of Project status, information on design and timeline; • Status of pipeline alignment and administrative aspects such as approach and timelines for land acquisition; • Any Project related stakeholder engagement conducted and related grievances.
Lai Uyen Townlet	3	• Mr. Đặng Văn Tuấn - Vice chairman of Lai Uyen TPC • Mr. Hồ Phương Nam - Cadastral officer of Lai Uyen TPC • Mr. Huỳnh Văn Phước - Head of Cay San hamlet, Lai Uyen Town	• Obtain up to date socio-economic data about demography, infrastructure and public services, health, livelihoods and employment, ethnic minority, and cultural sites in the locality; • Gain feedback or perceptions about the Project development and expectations to the Project for environmental and social performance management and impact mitigation.
Tru Van Tho Commune	3	• Mr. Trần Xuân Tùng - Chairman of Tru Van Tho CPC • Mr. Mai Thành Nhân - Cadastral officer of Tru Van Tho CPC • Mr. Nguyễn Khánh Toàn - Head of Hamlet 2, Tru Van Tho Commune	• Obtain up to date socio-economic data about demography, infrastructure and public services, health, livelihoods and employment, ethnic minority, and cultural sites in the locality; • Gain feedback or perceptions about the Project development and expectations to the Project for environmental and social performance management and impact mitigation.
Local households in Lai Uyen townlet	11	• Refer to the list of participants in Appendix D	• Disclosuree the pipeline construction information • Obtain information on demographics, source of assets, financial resources, socio-economic status of affected households, and level of satisfaction with local infrastructure and public services • Obtain concerns or perceptions about the pipeline construction
Local households in Tru Van Tho commune	14	• Refer to the list of participants in Appendix D	• Disclosese the pipeline construction information • Obtain information on demographiics, source of assets, financial resources, socio-economic status of affected households, and level of satisfaction with local infrastructure and public services • Obtain concerns or perceptions about the pipeline construction

Generally, the public consultation outcomes were not recorded any opinions against the project implementation. Table 7-2 and Table 7-3 below provides a summary of concerns and suggestions received during consultation with the local authorities and communities, respectively.

Table 7-2: Consultation results with commune-level authorities

Issue type	Matters raised by local authorities	
	Lai Uyen TPC	**Tru Van Tho CPC**
Land acquisition	● Concerns: The TPC representatives did not show any concerns regarding the land acquisition as the pipeline traverses under the safety corridor of the 110kV TL, which will not incur to land acquisition. ● Suggestions: The consultation with EVN to obtain their permission to work under the 110kV TL needs to be prioritized prior to implementing the pipeline construction.	● Concerns: The CPC representatives did not have any concerns regarding the Project devemopment. It is supposed that the Project will cause negligible disruption to local households due to a small land area acquired for construction and a short construction timeframe.
Project disClosure	● Concerns: The pipeline construction may cause disruptions to access local production land. Soil excavation could lead to soil runoff into adjacent fields, potentially disrupting cultivation activities. ● Suggestions: Restoring the land's original condition, minimizing any soil spillage during excavation	● Concerns: The Project construction may limit traffic during the construction time and potential land subsidence due to land excavation and filling, which may negatively affect the local environment in terms of dust, noise, and waste pollution. ● Suggestions: Implementing mitigation measures as specified in the EIA, informing local people on the commencement date, and returning the land to its original status after construction
Employment	● Opinion: The pipeline construction will not have any prominent impacts on local people's employment	● Opinion: The Project's impacts on local land-based livelihood under the 110kV transmission line are not significant.

Table 7-3: Summary of consultation with local communities

Issue Topic coveredtype	Concerns/Perceptions/Suggestions raised by local communities
Increasing vehicles and traffic disruption	● Concerns: local traffic routes may be influenced during the temporary road closure. Additional traffic loads may also cause traffic jam and disruption. ● Suggestions: Schedule construction traffic to avoid peak traffic periods and regular road maintenance as required
Potential impacts from dust, noise and soil erosion	● Concerns: noise and dust will be generated from construction activities. Moreover, vegetation clearance and excavation works may result in exposed soil, which lead to soil erosion both in cultivation areas and public roads ● Suggestions: construct the pipeline in the dry season, with the rolling installation period of 1-2 days for each section

Issue Topic coveredtype	Concerns/Perceptions/Suggestions raised by local communities
Community health and safety	● Concerns: health issues may be caused by the degrading of air and noise quality during the construction phase. ● Suggestions: Noise and air quality management plans with approporiate mitigation measures need to be developed and implemented onsite.
Local economy development	● Perception: support the development of the pipeline since it will ensure adequate water supply for local people, stabilize economic development and attract more investment to Binh Duong province.
Employment and business opportunities	● Perception: jobs and business opportunities will be created based on the demand of people. Employment and procurement will be considered to prioritize for local residents to participate.

Engagement activities will continue throughout construction and operation of the Project. This will involve engaging with local village heads and local authorities to disseminate information about the regarding the Project schedule and periods when larger volumes of traffic are expected. This IESE report will also be disclosed on the ADB website and will be made available to relevant stakeholders by TDM at the commune-level People's Committees, the TDM's headquarters, and other accessible public locations.

8. GRIEVANCE REDRESS MECHANISM

A grievance redress mechanism has been devised to allow stakeholders to raise grievances with the Sponsors. This section describes the grievance redress framework (informal and formal channels), setting out the timeframe and mechanisms for resolving complaints.

An effective stakeholder engagement process, which includes proactive provision of access to information regularly and conducting consultations to listen to the stakeholder concerns and feedback, can help prevent grievances from arising in the first place. A grievance procedure should be in place from the beginning of the social and environmental assessment process and maintained throughout the project life cycle. All grievances will be recorded in the issues/ grievances register to maintain transparency throughout any action taken relating to a grievance.

During construction and operation, several options will be available to stakeholders to lodge grievances. Grievances can be submitted to the Project through grievance boxes which can be allocated in the office of the affected commune People's Committee; at the site office of the Project Company; directly via a telephone hotline to the grievance team of the Project; or directly submitted to Stakeholder Manager of the Project.

It is anticipated that stakeholders may also relay grievances to village leaders, local authorities, or workers involved in the Project. If this occurs, these individuals will be asked to communicate the grievance to the Stakeholder Manager of the Project or the Project site manager so that the grievance can be readily investigated and resolved.

The Project should appropriately recruit and allocate human resources to manage the procedure. Ideally, persons with social/community management backgrounds should be recruited and assigned as a Stakeholder Manager. Ideally this could include local community members with the requisite skill set. Also, the Project should assign resources to set up a Grievance Committee. Members of this Committee typically include senior managers of the Project. During the construction phase, senior managers of the Contractor shall be involved in discussing and resolving the issues relating to their activities.

Details of each step in a grievance procedure are illustrated as follows:

Step 1: Receive and log grievance

The grievance should be received by the Project representative. Ideally a member of a communication or community relations function (e.g. Community Liaison Officer) should be responsible for this. The Stakeholder Manager (SM) logs the grievance using the Grievance Form and ensures that it is captured in a Grievance Log to monitor actions taken in resolving the grievance.

Step 2: Acknowledge grievance

The SM should communicate, verbally and documented in writing, with the grievant acknowledging receipt of the grievance and providing information on the proposed steps and the anticipated timeframes for resolving the grievance. The date of receiving the grievance shall be recorded in the Grievance Form.

Step 3: Classification of grievance and forward to relevant department

The SM should review and classify the grievances based on their nature and forward them to the relevant department. Grievances relating to the Project activities can be classified into two levels of complexity. Simple grievances are considered local (family to small area level) in nature and do not attract the

attention of media. Complex grievances are either recurring and/or potentially affect the community (large group to village/commune level) and/or attract attention of media.

Step 4: Investigate and resolve grievances relating to the Project activities

If the grievances are assessed simple, direct interaction between the SM and the grievant(s) shall be conducted. Solutions can then be developed and implemented.

If the grievances are considered as complex, immediate intervention of related parties such as senior managers, construction contractors, and/or village heads, local authorities seek their advice and then propose a resolution which is agreed by the parties in the discussion.

If the solutions are not accepted by the grievant(s), the SM should conduct consultation with the grievant(s) to obtain further detailed clarification on the issues and to try and agree upon a mutual solution. Minutes of consultation session shall be kept in the Grievance Log.

If a mutual solution cannot be obtained through consultation, third parties could be asked to be involved. The third party can provide advice or facilitation in a way that is acceptable to all parties. In addition, where mediation is desired, academic or other local institutions may be sought out to play an "honest broker" role in mediating between the Project and stakeholder groups.

Step 5: Follow up on grievances

The SM is responsible for seeking the grievant(s) responses/feedback on implementing the resolutions. The implemented resolutions shall also be recorded in the Grievance Form and kept in place as required. These activities are considered as follow-up actions.

Step 6: Documentation and reporting

All follow-up actions shall be tracked in the Project's Grievance Log. The SM is responsible for maintaining all records in the Grievance Log. The SM is responsible for preparing periodical reports to the Manager about the resolution of each grievance processed by the SM. The report will include the resolution and closure process.

9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The environmental and social management plan was prepared by ESC when final alignment - Option 3 was not developed for the IESE report preparation (Option 3 was finalized in Sep 2024 after the Draft IESE was completed). As such, the environmental and social management plan in this report is for Option 2 alignment. Should there be significant changes in the environmental and social management plan, TDM is to update accordingly to ensure compliance with ADB and JICA's requirements.

9.1 Management Plan

The proposed construction and operation phase mitigation measures are summarized in Table 9-1. This includes timing and responsibility for implementation of the measures.

Table 9-1: Mitigation Measure

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
Construction				
Noise	• Equip all construction machinery with well-maintained mufflers and sound control devices. • Place noisy portable equipment away from residential areas and enclose them within sound-muffling structures. • Avoid prolonged idling of equipment not in use; shut them off. • Designate construction haul routes to minimize impact on residential areas. • Restrict construction hours to 7:30 am-5 pm, avoiding noisy activities during post-lunch nap time near DT750 Provincial Road junction. • Minimize concurrent operation of noisy equipment and construction activities to reduce combined noise levels.	Part of construction cost as daily operation and maintenance and good practices adoptation. No additional budget required.π	Prior to and during construction	TDM Construction Contractors
Air Quality	• Develop a construction schedule and workforce arrangement to minimize dust generation. • Conduct excavation and grading on low-wind days to reduce dust dispersion. • Provide appropriate PPE for workers.	Part of construction cost as daily opearation and maintenance and good practices adoptation. No additional budget required.	Prior to and during construction	TDM Construction Contractors

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	• Utilize on-site excavated soil to eliminate off-site transport. • Spray water at least twice daily in dust-prone areas, using on-site well water. • Cover construction materials on site with tarpaulin to prevent dust • Organize regular cleaning of main roads and worker entrance areas. • Periodically inspect and maintain construction machinery to reduce emissions. • Ensure compliance with transport regulations, covering material transport vehicles and avoiding overloading. • Schedule material transportation during non-peak hours. • Clean vehicles at entry points to remove mud and dirt before entering transportation routes. • Deploy cleaning crews regularly to clear material debris spilled during transportation. • Equip welders with appropriate PPE. • Restrict access for non-involved individuals during welding and cutting activities. • Regularly inspect and maintain welding and cutting tools. • Backfill excavated soil promptly after pipe-laying works are completed within the worksites • Ensure that the cap of all soil storage trucks is covered with tarpaulins; controlling lorries loading capacity to avoid spillage; • All machineries, such as excavators and generators should be regularly			

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	maintained, to minimize smoke and dust exhaust emissions; and • Fully switch-off vehicles and equipment when they are not in use.			
Water Quality	• Proper on-site management of construction waste and chemicals, ensuring storage in appropriate containers with caps, and providing secondary containment for liquid chemical storage. • Excavate and dispose of top layers of existing sludge at the Bau Bang WTP expansion area to a third-party collector. Additionally, excavate the underlying topsoil layer by a minimum of 20cm to remove all sludge and contaminated soil before construction. • Implement surface protection and drainage works following earthworks to prevent erosion caused by rainstorms. • Construct concrete drains at the perimeter of the WTP expansion facility to cater for increased runoff due to surface changes • Regular inspection and maintenance of all drainage facilities and sediment control structures to ensure proper and efficient operation, particularly during rainstorms.Develop and implement a Surface Water Management Plan, including measures to address wastewater discharges from construction activities.	Part of construction cost as daily opearation and maintenance and good practices adoptation. No additional budget required. Sludge disposal by Biwase is estimated to be 1,500,000 VND/10 m^3 (about US$60/10 m^3). Total budget depends on depth of the sludge. About US$5-10k to engage consultant to prepare Surface Water Management Plan if not developed by inhouse staff.	Prior to and during construction	TDM Construction Contractors
Waste Management	• Collect domestic solid waste on-site daily and categorize it at the temporary storage.	Part of construction cost as daily opearation and maintenance and good practices adoptation. No	Prior to and during construction	TDM Construction Contractors

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	• Classify waste into categories: construction waste, recyclable waste, and hazardous waste, each with designated storage areas. Dispose of waste through a registered and licensed waste vendor to approved landfills and/or treatment facilities. • Ensure all discharges during construction adhere to local government requirements. • Excavate and dispose of sludge on the top layers of the Bau Bang WTP expansion site by a third-party waste collector. Excavation should reach 20cm into the soil layer to remove all sludge and potential contaminated soil before construction. • Implement surface protection and drainage works following earthworks to prevent erosion caused by rainstorms. • Develop and implement a Waste Management Plan for the Project, emphasizing international industry practices such as waste avoidance, reduction, segregation, and recycling when possible. • Reusable waste such as nylon, cardboard, cans, and bottles can be used as scrap to continue being recycled. Waste that cannot be recycled will be collected and treated by a licensed unit everyday in accordance with the provisions of Decree 08/2022/ND-CP dated October 10/ 1/2022 of the Government. • Arrange 2-3 temporary disposal area, each disposal area is from 10-20 m^2, which has a load of about 5-10 m^3 of construction solid waste.	additional budget required. Solid waste disposal by Biwase is estimated to be maximum at US$ 2,400 (300,000 VND/tonne or US$12/tonne for 200 tonnes)[57] Sludge disposal by Biwase is estimated to be 1,500,000 VND/10 m^3 (about US$60/10 m^3). Total budget depends on depth of the sludge. About US$5-10k to engage consultant to prepare Waste Management Plan if not developed by inhouse staff.		

[57] Following Decision No.64/2016/QĐ-UBND of Binh Duong PPC on unit price for solid waste collection in Binh Duong province.

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	• At the disposal site, a separate container to be collected daily; • Hazardous waste generated to be collected and separated from other types of solid waste and stored in a temporary hazardous waste warehouse. In the warehouse, arrange 4 orange sealed containers labeled with appropriate hazardous waste codes according to regulations. • 3-5 mobilised toilets to be installed onsite. The mobilized toilets waste will be collected every 2 weeks. • Develop and implement a Waste Management Plan for the Project, emphasizing international industry practices such as waste avoidance, reduction, segregation, and recycling.			
Land access and Livelihoods	• Conduct detailed measurement survey, census and inventory of losses for all households and business owners to be impacted by he project's temporary land access and access restrictions before the installation of the transmisttal pipeline; • For crops and trees affected along the pipeline: TDM will cooperate with the Construction Contractor to arrange for engagement, notification, negotiation and compensation of potential affected trees to local households and land owners; • The temporary land access process will be conducted in line with applicable laws and regulations; • To avoid the use of extra public land for construction of transmisttal pipeline; • Identify ways to reduce access restrictions on Segment 1 of pipeline	Part of construction cost. About US$5-10k for land surveys work. Administrative time from TDM and contractor during land negotiation and access, and follow up on policy implementation. Supporting affected livelihood/land uses of about US$ 17,600 (about US$800/household * 22 households). Land access and compensation budget to be estimated after land surveys are done by contractor. The implementation of Resettlement Plan is	Prior to and during construction	TDM Construction Contractors

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	crossing Provincal Road as much as possible; • To put in place a non-tolerance of forced eviction and land grab policy; • The entitlements shall be identified based on the principles of replacement cost with the aim to at least restore to pre-project status or improve the standard of living; • To apply internal land acquisition policy with a clear schedule/timeline for implementation; • To ensure that the stakeholders have access to a grievance mechanism for the communication of any grievances and concerns regarding the project's temporary land access; • To ensure that the payment of compensation is based on fair market value and disbursal of entitlements for impacted assets are completed prior the physical use of the land; • To establish the cut-off date–identrification of displaced persons who are eligible to receive compensation and assistance; • The policy on notification before the recovery of agricultural and non-agricultural land to be practiced.	expected to cost about US$ 2,000 monthly.		
Infrastructure and Service	• To consult with local transportation authorities on the road Closure plan and traffic diversion / Traffic Management Plan (TMP) that will be developed for the Project. • Implement the Traffic Management Plan • To carry out public consultation to all households along the DT750 road junction at least 1 week before the construction starts; • Schedule construction traffic to avoid peak traffic periods;	Part of construction cost as daily opearation and maintenance and good practices adoptation. Administrative time only for consultation, work scheduling and recording.	Prior to and during construction	TDM Construction Contractors

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	• Spray water regularly at the above junction during construction; • Site reinstatement and rehabilitation will be performed including repairing any damage caused; • Record complaints under the Grievance Mechanism process and follow up by identifying the causes.			
Community health and safety	• Coordinating with local authorities and relevant agencies to organize programs such as education and awareness raising for workers. • Coordinating with local authorities to manage temporary resident registration for migrant workers and to monitor social security in the area where migrant workers will be accommodated. • Construction Contractor should conduct compulsory medical examinations (i.e., annual health check-ups) for Project workers including contractors as required by national regulations to ensure they are fit for work and to monitor the prevalence of communicable diseases; • Construction Contractor should establish an onsite health clinic for Project workers involved in construction; • TDM and Construction Contractor should maximise local employment; • Construction Contractor should implement a "zero tolerance" policy towards inappropriate behavior from and amongst the workforce • Construction Contractor should register temporary residence for non-local workers to local authorities to ensure the management of Project's related workforce • Construction Contractor should develop a Project Code of Conduct; • Construction Contractor should share the Project Code of Conduct with	Part of construction cost as daily opearation and maintenance and good practices adaptation by contractor. Administrative time only for consultation and coordination, prepare Traffic Management Plan (TMP), develop policies and implementation etc. Annual health screening about US$10k for 100 workers. US$ 10-20k for SEP if prepared by third party consultant. Community Liaison Officers can be from in-house TDM staff, or engaging new staff, so budget depends on the candidate and is estimated to be US$1,000/month.	Prior to and during construction	TDM Construction Contractors

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	workers of contractors and requesting their compliance; • Construction Contractor should develop and implement regulations/policies for non-local workers staying in construction camps regarding behaviour towards local communities and restricting hours for going out; • All construction equipment will be fitted with well-maintained mufflers and noise control devices. • Portable equipment producing excessive noise will be strategically located away from residential areas and enclosed within sound-dampening structures whenever possible. • Idling of equipment will be strictly limited, and engines will be shut down when not in use. • Construction traffic will be routed to minimize disruption to residential neighborhoods. • Work hours will be restricted to 7:30 am - 5 pm, with noisy activities avoided during typical post-lunch quiet hours near the DT750 Provincial Road junction. • Efforts will be made to stagger the operation of noisy equipment and activities to reduce overall noise levels. • Water spraying will be conducted at least twice daily in areas prone to dust generation. • Main access roads will be regularly cleaned to prevent dust accumulation. • To cover construction materials on site with tarpaulin to prevent dust • All material transport vehicles will adhere to relevant regulations, including weight restrictions to avoid overloading. • A comprehensive Traffic Management Plan (TMP) will be developed in consultation with local transportation authorities to address			

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	road Closures, detours, and potential traffic impacts, particularly at the DT750 Provincial Road junction where the pipeline will cross. • TDM will develop and implement the SEP. Community Liaison Officers of the Project will be assigned and deliver induction training to provide guidance on requirements for culturally appropriate behaviours and an overview of the risks to migrant staff and workers. The training will include key cultural sensitivity awareness topics/programs to ensure workers including security staff do not unintentionally offend the local community. • TDM should establish and disclose a grievance mechanism to community.			
Occupational health and safety (OHS)	• Prepare an OHS management plan • Comply fully with Vietnamese labour laws • Regular medical check-ups • Having buddy system of at least 2 workers/ persons at construction area • Providing sufficient water and refreshment to workers • Available shelter for workers to rest during lunch time or break time; • Create and implement mandatory health and safety training courses for all workers and contractors; • Require all sub-contractors and suppliers to comply with OHS requirements at site; • Provide sufficient PPEs for all personnel; • Monitor, record and report all Health, Safety and Environmental (HSE) matters on a monthly basis; and • The EHS officer to regular monitor OHS on site during construction	Part of construction cost as daily opearation and maintenance and good practices adaptation by contractor. Annual health screening about US$10k for 100 workers. Administrative time only for TDM EHS personnel to organise training to workers and implement EHS requirement. About US$1,500-2,000/month if engaged full time EHS for the Project.	Prior to and during construction	TDM Construction Contractors

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	period and recommend improment where relevant. • If accommodation is required for workers, construction contractor will prepare a worker accommodation plan to specify requirements on the quality and management of the accommodation and provision of basic services satisfactory with ADB SPS[58], e.g., adequate sanitary facility, non-discrimination and equal opportunity, including prevention of SEAH[59] or not restrict their freedom of movement or of association.			
Cultural heritage	• Provide training of the existing Chance Find Procedure to the contractors and workers • Coordinate with relevant authorities to disclose the Chance Find Procedure to the local communities	Administrative time only.	Prior to and during construction	TDM Construction Contractors
Operation				
Waste and Sludge Management	• Fully excavate existing sludge on the future expansion area, collecting it for treatment by BIWASE. Excavation should extend at least 20cm below the sludge to remove all contaminated soil before construction. • For the existing earth pond within the Bau Bang WTP not included in approved designs, impermeable lining is required if used for overflow water from sludge during heavy rain. • Optimize sludge basin utilization during operation, regularly collecting sludge (monthly based on treatment capacity) to maintain capacity for upcoming treatment batches.	Sludge disposal by BIWASE is estimated to be 1,500,000 VND/10 m3 (about US$60/10 m3). Total budget depends on depth of the sludge. Impermeable liner cost included in the construction cost. Administrative time for good practices implementation, preparation of waste management plant and conduct site audits by TDM EHS in-house staff.	Throughout operation	TDM

[58] https://www.adb.org/sites/default/files/institutional-document/915711/environmental-and-social-framework-w-paper.pdf
[59] sexual exploitation, abuse, and harassment

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	• Enhance hazardous waste storage area to meet regulations, with proper signage, segregation, labeling, and restricted access for authorized personnel only. • Implement regular monitoring of sludge quality at drying beds following QCVN 50:2013 –National Technical Regulation on Hazardous Threshold for Sludges from Water Treatment Process to ensure sludges quality is not classified as hazardous waste • Develop a comprehensive Waste and Sludge Management Plan for the project, emphasizing international industry practices for waste avoidance, reduction, segregation, and recycling. • Sludge will be collected by licensed third party waste collector for proper treatment process; • Conduct monthly site audits to verify project compliance with outlined mitigation measures in the ESMP	Sludge monitoring by BIWASE as part of operation cost.		
Chemical Usage and Storage	• Implement effective site management practices for proper on-site product storage, utilizing paved areas with secondary containment to prevent spills. • Execute the Site Emergency Plan (SEP) and a comprehensive stakeholder engagement program focusing on emergency response. • Follow routine inspection and maintenance procedures, aligned with international best practices, for storage of hazardous substances. • Install warning systems, signal boards, and lightning protection	Part of construction and operation cost to include in the bid by contractor. Administrative time from TDM EHS inhouse staff for developing and implementing plans etc. US$30-40k if prepared by third party consultant for Site Emergency Plan, Emergency Preparedness and Response Plan, and specific Chlorine Management Plan.	Throughout operation	TDM

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	systems in areas exposed to risks of fire, explosion, or toxic chemicals. • Develop an Emergency Preparedness and Response Plan, including forest fire protection, and monitor contractors to ensure consistent implementation. • Maintain operational and available fire response facilities, subject to routine EHS audits by TDM personnel. • Conduct regular safety, fire prevention, and fire drills to enhance emergency preparedness. • Develop a specific Chlorine Management Plan (details the procedures to handle, storage, usage with appropriate requirements ọn monitoring/reporting, roles and responsibilities to implement the plan onsite) before starting the operation phase following Article 38 of the Law on Chemical 06/2007/QH12 and Clause 1 Article 20 Decree No. 113/2017/ND-CP. • TTDM to follow the guideline of Law on Chemicals 2007 and Decree 113/2017/ND-CP on fire safety of flammable chemical. • Follow technical standards on buffer distance (TCXDVN 33:2006 Water Supply Distribution System and Facilities Standard) which recommends a buffer distance of 300m from chlorine storage facilioties to residential households. • Monitor chlorine concentration regularly in the surrounding storage areas. • Provide regular training on Emergency Response for Chlorine Gas Leakage and Chemical Spill incidents.			

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
	• Communicate the Emergency Response Plan for Chlorine Leakage incidents to the communities			
Aquatic Life	• Install trash rack and fine mesh (as small as possible for practical design and operation of the intake structure – with recommendation of 5mm mesh size) at the inlet to prevent debris and minimize small fish entry.	Part of construction cost to include in the bid by contractor.	Prior to operation	TDM
	• Monitor intake flow daily during the first year of operation. If it excceds 0.15m/s, redesign screening structure or implement other measures to reduce flow below 0.15m/s. (or as low as practically possible)	Part of operation cost to be monitored by operation staff.	Daily during the first year of operation	TDM
	• Include daily visual inspections for fish presence and potential issues at the intake point.	Part of operation cost to be monitored by operation staff. If additional staff is engaged, it is about US$1,000/month.	Daily throughout operation	TDM
Occupational health and safety (accidents and injuries)	• An Occupational Health and Safety Plan will be prepared and implemented; • To comply with Vietnamese labour laws as per TDM OHS compliance; • Regular medical check-ups where required; • To conduct mandatory health and safety training for all workers and contractors prior to work starting on operation; • To provide workers with the required and appropriate PPE; • All staffs have to be able to swim; • Monthly site audits will be carried out.	Part of operation cost. Administrative cost by TDM EHS personnel to prepare OHSP and monitor the implementation. US$20-30k if prepared by third party consultant. Staff regular medical checkup about US$100/pax.	Throughout operation	TDM
Community health and safety	• To develop and implement a Workforce Code of Conduct;	Part of operation cost.	Throughout operation	TDM

Predicted Impact Issue	Mitigation Issue	Cost/ estimated budget	Schedule	Responsibility
(accidents and injuries)	• A Waste Management Plan should be developed to control and manage of transport and disposal of all wastes on and off site; • Ensure that there is adequate fencing around the project site • Fencing will be checked periodically to ensure that it is in good condition and to look for any signs of entry; • A Stakeholder Engagement Plan should be developed to ensure local communities are kept updated on Project activities.	Administrative time of TDM EHS inhous staff only. US$ 10-20k for SEP if prepared by third party consultant.		

9.2 Monitoring Plan

The parameters and methods have been recommended for monitoring the predicted impacts and the implementation of the proposed management measures. All monitoring data (such as site inspection and observation notes) will be recorded and maintained on site.

The data generated through the monitoring plan will be used to evaluate the efficacy of the management measures in mitigating the predicted impacts on an on-going basis during construction and annually during operation. Based on the monitoring results and the evaluation process, any issues of concern will be investigated, and where required, corrective actions will be implemented. Any required changes or modifications to the management measures will be reflected in the ESMP.

Following EIA report, TDM has to submit an evironmental protection report to MONRE annually during operation phase of the project. For construction phase, due to the short duration, TDM will monitor and record the monitoring results by themselves and submit an environmental protection report to MONRE by quarterly basis. The results of the monitoring and evaluation process will also be monitored by TDM and reported annually to the ADB and JICA during construction and operation phase. This will include the results of the monitoring activities, details of any impacts that occurred and changes or modifications made to the ESMPs.

Table 9-2: Monitoring Plan

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
Pre-construction						
Land-use and livelihoods	Detailed measurement survey Inventory of losses and damaged assets	Project site	Site records	ADB SPS Safeguard Requirements 2: Involuntary Resettlement IFC Good Practice on Land Acquisition and Involuntary Resettlement	One time before construction phase start	TDM and Construction Contractor to record
Construction						
Noise	• Any complaints from nearby residents • Ambient noise level (dBA) at sensitive receptors and espically at the complaints's location when complaints are recieved	• At location of the respected sensitive receptor where complaints are reported • Two sensitve receptors as specified in Section 5.8: one nearby the WTP (location KK.016)	Site inspection and quantitative measurement as 1-hour Leq for both daytime and nightime.	QCVN 26:2010: National Technical Regulation on Noise Level IFC General EHS Guidelines	• Quarterly monitoring throughout construction by third party. • Daily site inspection during construction. • Noise monitoring at sensitive receptors when complaints are received.	TDM to engage third party to conduct monitoring TDM to conduct site inspection

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
		and one on the pipeline route (location KK.014) • One addtional location crossing DT750 (location KK.019) for receptors along the first 1.5km of the pipeline				
Air quality	Ambient air	• Two sensitve receptors as specified in Section 5.8: one nearby the WTP (location KK.016) and one on the pipeline route	• Site inspection and quantitative measurement as • Particulate matter 10 (PM10) and particulate matter 2.5 (PM2.5) over 24- hour periods with a	QCVN 05:2023/BTNMT: National Technical Regulation on Ambient Air Quality IFC General EHS Guidelines	• Daily visual inpsection • Quarterly monitoring throughout construction by a third party.	• TDM to engage third party to conduct monitoring • TDM to conduct site inspection

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
		(location KK.014) • One addtional location crossing DT750 (location KK.019) for receptors along the first 1.5km of the pipeline	filter rate of 5 L/min; and • Total suspended Particles (TSP), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) were monitored over 1-hour periods with an air flow rate of 1000 L/min for TSP, 0.5 L/min for NO_2 and SO_2, and 0.05 L/min for CO.			
Surface Water Quality	Visual turbidity, un-managed discharge or leakages/ spills to natural water. pH, BOD5, COD, TSS, Total N, Total P, Oil and Grease, Coliform	Natural flow on the transmission pipeline from Tru Van Tho pump station to Bau Bang WTP (location NM.007 as provided in Section 5.7.1) .	Daily visual site inspection for turbidity and any un-mannaged discharged or leakages/ spills. Collect water samples for	QCVN 08:2023/BTNMT: National Technical Regulation on Surface Water Quality IFC General EHS Guidelines	• Daily visual inspection for turbidity, un-managed discharge or leakages/ spills to natural water	•TDM to engage third party to conduct monitoring •TDM to conduct site inspection

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
			laboratory analysis (Quantitative measurement)		• Quarterly monitoring throughout construction by third party	
Wastewater Quality	pH, BOD5, COD, TSS, Total N, Total P, Oil and Grease, Coliform	One location at site wastewater discharge point	Weekly visual site inspection for any un-mannaged discharged or leakages/ spills. Collect waste water samples for laboratory analysis (Quantitative measurement)	QCVN 40:2011/BTNMT: National Technical Regulation on Industrial Wastewater Quality	• Weekly inspection • Quarterly monitoring throughout construction by third party	•TDM to engage third party to conduct monitoring •TDM to conduct site inspection
Solid Waste and Hazardous Waste	Type of waste with quantities of waste generation Conditions of hazardous waste storage	Temporary domestic and construction waste collection points Temporary hazardous waste storage	Site records detailing volume of waste, date of collection, person – in – charge etc.	Decree No. 08/2022/NĐ-CP Circular No. 02/2022/TT-BTNMT	Weekly records throughout construction	TDM internally record
Land-use and livelihoods	Percentage of local employees Grievances related to compensation	Project site	Site records by stakeholder log, grievance log,	ADB SPS Safeguard Requirements 2: Involuntary Resettlement	Bi-annually throughout construction	TDM and Independent

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
	Number of engagement activities Spending for compensation activities Satisfaction of household on the compensation Use of household on the compensation		employee log, etc	IFC Good Practice on Land Acquisition and Involuntary Resettlement		Monitoring Consultant to record
Occupational health and safety (Accidents and injuries)	Unsafe behaviours or practices	Project site	Site inspection and observation of health and safety practices Incident/ accident records.	International Labour Organization (ILO) Guidelines on Occupational Safety and Health Management Systems Law on Occupational Safety and Health (No. 84/2015/QH13)	Monthly monitoring throughout construction	TDM internally record
	Health and safety incidents	Project site	Site records detailing incidents/ accidents			TDM internally record
	Percentage of staff receiving site inductions	Project site	Induction records maintained on site			TDM internally record
	Grievances relating to health and safety	Not Applicable (NA)	Grievance mechanism, site records of complaints/ feedback etc.			TDM internally record

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
	Community health and safety incidents	NA	Site records detailing incidents/ accidents			TDM internally record
	Worker accommodation non-compliance issues (if worker accommodation to be deployed onsite) .	Worker accommodation onsite if there is	Site records details non-compliance issues on fire safety, sanitation, light, ventilation, etc	IFC/EBRD Guidance on Workers' Accommodation	Monthly monitoring throughout construction	TDM internally record
Employment	Positions created, positions filled by locals, wages paid	NA	Employment strategy	IFC Good Practice Note on Managing Contractors' E&S Performance	Monthly monitoring throughout construction	TDM internally record
Operation						
Domestic Wastewater	pH, BOD5, COD, TSS, total N, total P, Coliform, Cl-, As, Cd, Cr, Hg, Pb, Ecoli;	Discharge point after septic tanks	Site inspection and quantitative measurement	QCVN 14:2008/BTNMT: National Technical Regulation on Wastewater	Quarterly monitoring throughout operation	TDM to engage third party to conduct
Waste and Sludge	Quantity and quality of sludge generation and heavy metals concentration	Project site	Site records detailing volume of sludge, quantitative measurement and records of sludge collection by third party.	QCVN 50:2013/BTNMT: National Technical Regulation on Hazardous Threshold for Sludge from Water treatment process	Quarterly monitoring throughout operation	TDM to engage third party to conduct

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
Chemical Usage and Storage	Type of chemical with quantities of chemical usage Concentration of Chlorine surrounding Chlorine house Quantity of diesel, Lime, PAC and Chlorine usage	Project site	Site records detailing volume of chemical usage Quantitative measurement on Chlorine concentration	Vietnam Law on Chemicals 2007 Decree 113/2017/ND-CP Circular 04/2012/TT-BCT Circular 48/2020/TT-BCT	Daily records throughout operation	TDM internally record
Solid waste	Type of waste with quantities of waste generation	Project site	Site records detailing volume of waste, date of collection by third parties etc.	Decree No. 08/2022/NĐ-CP Circular No. 02/2022/TT-BTNMT	Weekly records throughout operation	TDM internally record
Aquatic Life	Visual inspection at the intake structures to check for any signs of entrapment or present of fish.	Intake point and vicinity	Visual inspection at the intake structures and vicinity	IFC EHS Guidelines on Water Consumption and Aquatic Habitat Alteration	Daily, weekly, monthly throughout operation Regularly review and update monitoring protocols and mitigation measures If any unusual or rare dead fish is observed near the intake point, especially those that seem uncommon or are not commonly found in the area, promptly report the	TDM internally record

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
					sightings to relevant environmental authorities and seek guidance and consultation from biodiversity specialists to determine these species biodiversity value (EN or at risk, etc). If needed, implement specific monitoring programs to assess their populations and movements, and take appropriate measures to protect them from potential risks associated with the intake point.	
Occupational health and safety (accidents and injuries)	Unsafe behaviors or practices	Project site	Site inspection and observation of health and safety practices; Records of incidents/ accidents.	International Labour Organization (ILO) Guidelines on Occupational Safety and Health Management Systems	Bi-annually throughout operation	TDM internally record

Impact Issue	Parameter	Location	Method of Monitoring	Reference Regulations/Frameworks	Frequency	Responsibility
	Health and safety incidents	Project site	Site records detailing incidents/ accidents	Law on Occupational Safety and Health (No. 84/2015/QH13)	Bi-annually throughout operation	TDM internally record
	Percentage of staff receiving site inductions	Project site	Induction records maintained on site		Bi-annually throughout operation	TDM internally record
	Grievances relating to health and safety	NA	Grievance mechanism, and records of complaints/ feedbacks.		Monthly monitoring throughout operation	TDM internally record
Community health and safety (accidents and injuries)	Community health and safety incidents	NA	Site records detailing incidents/ accidents		Bi-annually throughout operation	TDM internally record
Employment	Positions created, positions filled by locals, wages paid	NA	Employment strategy	IFC Good Practice Note on Managing Contractors' E&S Performance	Bi-annually throughout operation	TDM internally record

9.3 Roles and responsibilities of Construction ESMPs

The key parties and their primary roles in implementing the ESMPs are as follows:

- TDM – as the Project Proponent is responsible for the overall Project monitoring, ensuring compliance with environmental policy and obligations in the ESMP;
- Construction Contractor is responsible for complying with ESMP requirements set out by TDM;
- Indepdent Consultant is responsible for auditing the implementation process of Resettlement Plan and;

The guidance on the types of roles and responsibilities that would be required for implementation of the ESMPs during construction phase.

9.3.1 Project Director

TDM's Project Director is responsible for all construction activities and accountable for overall Environmental, Health, Safety and Security ("EHSS") performance of the Project during construction phase. Expectation for the role in terms of implementing a management system would include:

- Actively promoting and participating in the Project ESMPs;
- Ensuring that the ESMPs, procedures and work practices are implemented across the Project;
- Ensuring that the ESMPs reflects the requirements of the Project in terms of resources and budget;
- Ensuring that all legislative and company requirements are complied with;
- Reviewing the implementation of the ESMPs;
- Ensuring sufficient budget and capacity is provided to implement the ESMPs;
- Ensuring that all work scopes are conducted in accordance with the Project EHSS rules and regulations, work practices and procedures, as detailed in this ESMPs and other associated documentation;
- Ensuring that all contractors are made aware of their roles and responsibilities with regard to EHSS management;
- Ensuring that EHSS is regularly discussed and reported on i.e. in the weekly contractor progress meeting;
- Ensuring that all contractors are evaluated throughout the duration of the Project, as to their capabilities and performance; and
- Reporting to the TDM at corporate level on project ESMPs implementation;

9.3.2 EHSS Manager

TDM's EHSS Manager would be expected to undertake the following roles:

- Managing, reviewing and developing the ESMPs to ensure that it fulfils Project requirements, including measures observed in this ESMP, and monitor the implementation including e.g. patrolling the job site daily to ensure construction works' compliance to Project EHSS Procedures and safe working practices;
- Coordinating and evaluating the effectiveness of all program elements;

- Liaisoning with related government bodies as necessary;
- Managing the Construction Contractor EHSS team and supervise them to ensure that all areas of the project are given the required level of safety support and attention;
- Ensuring proper housekeeping and waste disposal in accordance with company requirements and regulations;
- Ensuring that the respective control areas are given in the required level of safety support and attention including e.g. only safety-approved material and equipment are allowed to be brought onto site;
- Planning and executing related ESMP trainings;
- Documenting all EHSS reports/records/approvals, etc;
- Ensuring ESMPs is implemented and regularly review it effectiveness;
- Ensuring that all EHSS reports/findings of any unsafe conditions/practices is brought to the attention of field management and those are immediately corrected, and coordinate accident/incident investigations and report to Project Director; and
- Managing internal inspections / third-party monitoring events and report the results of ESMPs implementation to the Project Director.

9.3.3 Stakeholder Manager

The Stakeholder Manager, employed by the TDM, would be expected to undertake the following roles:

- Coordinating and evaluating the effectiveness of all program elements;
- Managing the implementation of stakeholder relations and grievance management to ensure that all social-related requirements in this ESMPs are implemented;
- Managing the implementation of community health program, including coordination with Construction Contractor EHSS team on OHS measures associated with management of impact to community health;
- Coordinating with EHSS Manager on implementation of the Project vehicle safety measures associated with management of impact to community safety;
- Coordinating with HR (Human Resources) person to ensure implementation of labour-related measures required in this ESMPs;
- Consultating with community and liaison with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaison with related government bodies as necessary;
- Leading collaboration to establish and implement the Project grievance mechanism during construction phase, and supervise contractor's social performance as required in this ESMPs; and
- Managing social monitoring and reporting the results to the Project Director.

9.3.4 Construction Contractor EHSS Team

The Construction Contractor and its sub-contractors, depending on their work scopes, would be expected to have an EHSS team onsite. The contractors' site representatives or EHSS team should be assigned clear responsibilities and expectations with respect to implementing the Project's EHSS expectations and

should be fully responsible for implementing any required expectations which fall under their work scopes. More specifically, they will:

- Actively promoting and implementing all ESMPs related with the work they are preforming. The contractor will make sure that all activities under his/her responsibility shall follow the ESMPs and all safety regulation/requirements, coordinating with the Project Director;
- Actively implement the ESMPs onsite and report to TDM representatives (EHSS Manager) on the monitoring results/non-compliance records as required.
- Ensuring that committed resources (personnel, material, and equipment) used are consistent with achieving the objectives and requirements of the Project's ESMPs.

9.3.5 Employees

Employees under management of TDM, contractoring themselves with the concept of the Project EHSS rules and regulations:

- Working in accordance with Project ESMPs, safe work practices, and method statements, risk assessments, permits to work and any other instructions that apply to their works;
- Using only tools/equipment and materials, which have been approved for use, and employ them only for the purpose for which they were designed;
- Taking an active part in the protection of themselves, fellow workers, property and the environment from accidental losses;
- Reporting to his respective supervisor or EHSS Manager/inspector if any potential hazards (relates to unsafe conditions and/or unsafe acts), which could lead to an accident, are found;
- Reporting promptly to immediate supervisor and HSSE officer/inspector if any incidents/near misses as well as injuries, regardless how minor; and
- Attending project safety training and drills programs as required.

9.3.6 Independent Consultant

The Independent Consultant is expected to monitor the process of detailed mesurement surveys and inventory of losses regarding land access and compensation activities to be conducted before construction phase start.

9.4 Roles and responsibilities of Operation ESMPs

The existing Bau Bang WTP has an EHSS committee to to manage and coordinate the environmental, health, safety, and social issues at the corporate and facility levels (regarding to Decision 32/QD-CPNTDM updated in July 2023). However to implement the ESMPs of the expansion project during operation phase, a new team (except WTP Manager) is recommended to be set up, which details the roles and responsibility as follow:

9.4.1 WTP Manager

Bau Bang WTP Manager is responsible for all construction activities and accountable for overall Environmental, Health, Safety and Security ("EHSS") performance of the Project during Operation Phase. Expectation for the role in terms of implementing a management system would include:

- Actively promoting and participating in the Project ESMPs;
- Ensuring that the ESMPs, procedures and work practices are implemented across the Project;

- Ensuring that the ESMPs reflects the requirements of the Project in terms of resources and budget;
- Ensuring that all legislative and company requirements are complied with;
- Review the implementation of the ESMPs;
- Ensuring sufficient budget and capacity is provided to implement the ESMPs;
- Ensuring that all work scopes are conducted in accordance with the Project EHSS rules and regulations, work practices and procedures, as detailed in this ESMPs and other associated documentation;
- Ensuring that all contractors are made aware of their roles and responsibilities with regard to EHSS management;
- Ensuring that EHSS is regularly discussed and reported on i.e. in the weekly contractor progress meeting;
- Ensuring that all contractors are evaluated throughout the duration of the Project, as to their capabilities and performance; and
- Reporting to the TDM at corporate level on project ESMP implementation;

9.4.2 EHSS Manager

TDM's EHSS Manager would be expected to undertake the following roles:

- Managing, reviewing and developing the ESMPs to ensure that it fulfils Project requirements, including measures observed in the ESMPs, and monitor the implementation including e.g. patrolling the job site daily to ensure construction works' compliance to Project EHSS Procedures and safe working practices;
- Coordinating and evaluating the effectiveness of all program elements;
- Liaisoning with related government bodies as necessary;
- Ensuring proper housekeeping and waste disposal in accordance with company requirements and regulations;
- Ensuring that the respective control areas are given in the required level of safety support and attention including e.g. only safety-approved material and equipment are allowed to be brought onto site;
- Planning and executing related ESMP trainings;
- Documenting all EHSS reports/records/approvals, etc;
- Ensuring ESMPs is implemented and regularly review it effectiveness;
- Ensuring that all EHSS reports/findings of any unsafe conditions/practices is brought to the attention of field management and those are immediately corrected, and coordinate accident/incident investigations and report to Project Director; and
- Managing internal inspections / third-party monitoring events and report the results of ESMPs implementation to the WTP manager.

9.4.3 Stakeholder Manager

The Stakeholder Manager, employed by the TDM, would be expected to undertake the following roles:

- Coordinating and evaluating the effectiveness of all program elements;
- Managing the implementation of stakeholder relations and grievance management to ensure that all social-related requirements in this ESMPs are implemented;
- Managing the implementation of community health program, including coordination with EHSS Manager on OHS measures associated with management of impact to community health;
- Coordinating with HR (Human Resources) person to ensure implementation of labour-related measures required in this ESMPs;
- Consultating with community and liaison with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaison with related government bodies as necessary;
- Leading collaboration to establish and implement the Project grievance mechanism during construction phase, and supervise contractor's social performance as required in this ESMPs; and
- Managing social monitoring and reporting the results to the WTP Manager.

9.4.4 Employees

Employees under management of TDM contractoring themselves with the concept of the Project EHSS rules and regulations:

- Working in accordance with Project ESMPs, safe work practices, and method statements, risk assessments, permits to work and any other instructions that apply to their works;
- Using only tools/equipment and materials, which have been approved for use, and employ them only for the purpose for which they were designed;
- Taking an active part in the protection of themselves, fellow workers, property and the environment from accidental losses;
- Reporting to his respective supervisor or EHSS Manager/inspector if any potential hazards (relates to unsafe conditions and/or unsafe acts), which could lead to an accident, are found;
- Reporting promptly to immediate supervisor and HSSE officer/inspector if any incidents/near misses as well as injuries, regardless how minor; and
- Attending project safety training and drills programs as required.

9.5 Training and Capacity Building

9.5.1 Construction Phase

Prior to commencement of major civil works at site, suitably qualified in-house/ external experts will be appointed by the Construction Contractor (see Section 9.3.4) in consultation with TDM to develop and deliver training programs on implementation of the ESMPs, monitoring and reporting will be conducted in line with the applicable reference framework for the Project. The training should include the following topics:

- Environment, Health and Safety Policy;
- Environment and fundamentals of environmental pollution in relation to the Project;

- Construction ESMPs;
- Do's and Don'ts for the construction workers;
- Safety procedures and guidelines;
- Internal reporting and response system;
- Hazardous chemicals and waste handling;
- Emergency and Response for incidents/accidents
- Fire prevention and firefighting;
- Grievance Redress Mechanism; and
- Chance find procedure.

In addition, specific training will be provided to the team involved in environmental and social monitoring and reporting, which will include:

- Applicable environmental and social guidelines and standards;
- Sampling site selection guidelines in line with environmental monitoring plan;
- Sample collection, storage, transportation and analysis procedures;
- Quality assurance (QA) and quality control (QC);
- Environmental impact and monitoring report preparation.

All records including training materials, list of partcipants and photo documentation of training sessions should be kept by TDM. The recommendation of training programs for construction phase is summarized in the table 9-3 below:

Table 9-3: Trainings during construction phase

Training content	Target trainee	Frequency	Duration
Development and adjustment of the Construction ESMPs, roles and responsibilities, monitoring, supervision, and reporting).	EHSS Manager Stakeholder Manager Construction Contractor EHSS Team	One time before commencement of construction phase	One day (4 hours)
Health and safety, pollution control on the construction site, and disturbance minimization during construction phase implementation	EHSS Manager Stakeholder Manager Construction Contractor EHSS Team	One time before commencement of construction phase	One day (6 hours)
Construction ESMPs implementation: mitigation measure, monitoring plan (methods, data collection and processing) including Grievance Redress Mechanism (roles and responsibilities).	EHSS Manager Stakeholder Manager Construction Contractor EHSS Team	One time before commencement of construction phase	One day (4 hours)

Training content	Target trainee	Frequency	Duration
Environmental Safeguard Monitoring Annually Report preparation	EHSS Manager	One time before commencement of construction phase	One day (4 hours)
Regulatory training on Hygiene and Occupational Health Safety according to Decree 44:2016/ND-CP	All site personnel	One time before commencement of construction phase	Two to three days

9.5.2 Operation Phase

Prior to the commencement of Project operation, suitably qualified in-house/ external experts will be engaged by TDM to develop and deliver training programs on operation phase environmental and social monitoring and reporting. The agenda of training programs should be covered but not limited to the following topics:

- Environment, Health and Safety Policy;
- Environment and fundamentals of environmental pollution in relation to the Project;
- Operation ESMPs;
- Do's and Don'ts for the operation workers;
- Safety procedures and guidelines;
- Fundamental Swimming and Drowing Prevention;
- Internal reporting and response system;
- Emergency and Response for incidents/accidents
- Fire prevention and firefighting;
- Hazardous chemicals and waste management;
- Occupational health and safety programs;
- Chlorine Emergency Response and Rescue for Chlorine leakage incidents/accidents;
- Aquatic life protection;
- Environmental impacts and monitoring report preparation; and
- Grievance Redress Mechanism

All records including training materials, list of partcipants and photo documentation of training sessions should be kept by TDM. The recommendation of training programs for operation phase is summarized in the table 9-4 below:

Table 9-4: Trainings during operation phase

Training content	Target trainee	Frequency	Duration
Development and adjustment of the operation ESMPs, roles and responsibilities, monitoring, supervision, and reporting.	EHSS Manager Stakeholder Manager	One time before commencement of operation phase	One day (4 hours)
Health and safety, pollution control at the WTP, and disturbance minimization during operation phase implementation	EHSS Manager Stakeholder Manager	One time before commencement of operation phase and refresh annually	One day (6 hours)
Operation ESMPs implementation: mitigation measure, monitoring plan (methods, data collection and processing) including Grievance Redress Mechanism (roles and responsibilities).	EHSS Manager Stakeholder Manager	One time before commencement of operation phase	One day (4 hours)
Environmental Safeguard Monitoring Annually Report preparation	EHSS Manager	One time before commencement of operation phase	One day (4 hours)
Regulatory training on Hygiene and Occupational Health Safety according to Decree 44:2016/ND-CP	All site personnel	One time before commencement of opeartion phase and repeat every 2 years	Two to three days
Fire Prevention and Firefighting and Emergency Response	All site personnel	One time before commencement of operation phase and refresh annually	One day (4 hours)
Emergency Response for Chlorine Gas Leakage Incident	All site personnel	One time before commencement of construction phase and refresh annually	One day (4 hours)
Site evacuation	All site personnel	One time before commencement of construction phase and refresh annually	One day (4 hours)

10. CONCLUSION AND RECOMMENDATIONS

This IESE report of Bau Bang expansion WTP and its associated facilities has been prepared based on the previous E&S audit report, FS technical report, draft local EIA report and available studies and reports relevant to the Project, site visits, environmental and social baseline data collection and the stakeholder engagement. As the final Option 3 was finalized in Sep 2024 after the Draft IESE was completed, the contents discussed in this report is for Option 2 alignment of the pipeline. Should there be significant changes, TDM is to update accordingly to ensure compliance with ADB and JICA's requirements.

1. Th

e Table 10-1 and

Table 10-2 below summarise the residual impact significanes. All impacts are expected to mitigated to Minor at worst case and having a range of mitigation, management and monitoring measures to ensure no significant impacts to the environment or local communities.

Table 10-1: Construction Impact Significance Summary

Key Aspect	Impact Type	Significance of Impact	
		Before Mitigation	With Mitigation
Environmental and Biodiversity			
Noise	Noise from construction vehicles and equipment, piling works	Minor	Negligible
Air Quality	Pollution from transport vehicles and construction machinery	Minor	Negligible
Water Quality and Hydrology	Degrade water quality by reducing clarity and introducing sediments	Minor	Negligible
Waste Management	Construction activities generate waste materials, including debris and discarded materials.	Minor	Negligible
Socio-Economic			
Land use and livelihoods	Land access will create local land use changes in the Project area, especially for formal and informal users. Livelihoods could potentially be adversely affected due to economic displacement from the project's temporary land access	Minor	Negligible
Infrastructure and Service	Traffic congestion might be caused due to the increase of vehicular volume on the main roads, stress on existing public infrastructure and services	Minor	Negligible

Key Aspect	Impact Type	Significance of Impact	
		Before Mitigation	With Mitigation
Occupational Health and Safety	High-risk activities with the potential for accidents that may result in injuries and potential fatalities	Moderate	Minor
Community Health and Safety	Influx of construction labour might cause social tension with local communities, degradation of local social norms, spread of communicable diseases and stress on existing public infrastructure and services	Minor	Negligible
Cultural Heritage	Excavation works can contact unknown heritage resources, particularly archaeological resources	Negligible	Negligible

Table 10-2: Operation Impact Significance Summary

Key Aspect	Impact Type	Significance of Impact	
		Before Mitigation	With Mitigation
Environmental and Biodiversity			
Waste and Sludge Management	The solid waste generated during the operation phase will predominately comprise of the sludge from the WTP process with limited of prevention methods	Minor	Negligible
Chemical Usage and Storage	Chemical used for treatment process and back up fuels may lead to leakage incidents; fire and explosion	Moderate	Minor
Aquatic Life	Impinging, entraining of aquatic species into the intake structure	Moderate	Minor
Socio-Economic			
Occupational Health and Safety	High-risk activities with the potential for accidents that may result in injuries and potential dieases	Minor	Negligible
Community Health and Safety	Influx of construction labour might cause social tension with local communities, degradation of local social norms, spread of communicable diseases and stress on existing public infrastructure and services	Minor	Negligible

The management plans with details of management strategies and monitoring plans will be required to be prepared for the project in order to ensure the project reduces, avoid, and mitigates the potential project impacts as follow:

Table 10-3: Recommendation of management plans

No.	Management Plan recommended	Project phase	Status
1	Air Quality Management Plan	Construction	New plan to be developed
2	Noise and Vibration Management Plan	Construction	New plan to be developed
3	Traffic Management Plan	Construction	New plan to be developed
4	Surface Water Management Plan	Construction and Operation	New plan to be developed
5	Chance Find Procedure	Construction	Existing plan to be enhanced
6	Worker Accommodation Management Plan (if worker accommodation needed onsite)	Construction	New plan to be developed
7	Waste Management Plan	Construction and Operation	New plan to be developed
8	Occupational Health and Safety Management Plan	Construction and Operation	Exisitng plan to be enhanced
9	Community Health and Safety Management Plan	Construction and Operation	New plan to be developed
10	Emergency Preparedness and Response Plan	Construction and Operation	Exisitng plan to be enhanced
11	Stakeholder Engagement Plan with Grievance Mechanism (Worker and Community)	Construction and Operation	New plan to be developed
12	Sludge Management Plan	Operation	New plan to be developed
13	Aquatic Life Management Plan	Operation	New plan to be developed

No.	Management Plan recommended	Project phase	Status
14	Chlorine Management Plan	Operation	New plan to be developed

APPENDICES

Appendix A: Bau Bang existing WTP design capacity and number of facilities or units

Appendix B: Aquatic life laboratory analysis results

Appendix C: IUCN Red List of Threatened Species Potentially Found Within 50km (IBAT)

Appendix D: Public consultation participant list

APPENDIX A: BAU BANG EXISTING WTP DESIGN CAPACITY AND THE NUMBER OF FACILITIES/UNITS

Associated Facility	Phase 1 (2017)	Phase 2 (2020)
Mixing tank	30,000 m3/d x 1 facility	No additional construction as it meets the capacity of 37,500 m3/d
Reaction-Settling Tank	15,000 m3/d x 1 facility	15,000 m3/d x 1 facility 7,500 m3/d x 1 facility additional
Rapid Filtration Tank	15,000 m3/d x 1 facility	15,000 m3/d x 1 facility 7,500 m3/d x 3 facility additional
Clean Water Pump Station	30,000 m3/d x 1 facility (3 x 500 m3/h, H = 45m)	Install 2 additional pumps (2x1000 m3/h, H = 45m) to meet the capacity of 37,500 m3/d
Clean Water Storage Tank	7,000 m^3 x 1 facility	No additional construction as it meets the capacity of 37,500 m3/d
Scanda Control Room and Chlorine Room	30,000 m3/d x 1 facility	Upgrade and install additional equipment to meet the capacity of 37,500 m^3/day
Transformer Station and Power Generator	30,000 m3/d x 1 facility	Upgrade and install additional equipment to meet the capacity of 37,500 m^3/day
Chemical Warehouse	30,000 m3/d x 1 facility	Upgrade and install additional equipment to meet the capacity of 37,500 m^3/day
Sludge Drying Field	30,000 m3/d x 1 facility	Upgrade and install additional equipment to meet the capacity of 37,500 m^3/day

APPENDIX B: AQUATIC LIFE LABORATORY ANALYSIS RESULTS

Appendix B-1: Benthos analyzing results

No.	Characteristic	Unit	AL1		AL2		AL3		AL4	
			Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative
1	GASTROPODA class	Individual/m^3	-		-		-		-	
2	BIVALVIA class	Individual/m^3	-		-		-		-	
3	MALACOSTRACA class	Individual/m^3	-		-		-		-	
4	POLYCHAETA class	Individual/m^3	-		-		-		-	
5	Other classes	Individual/m^3	-		-		-		-	
	Total Species		0		0		0		0	
	Density (population/volume)	Individual/m^3		0		0		0		0

Note:

*: Qualititative detected

-: Not detected

Appendix B-2: Zooplankton analyzing results

No	Characteristic	Unit	AL1		AL2		AL3		AL4	
			Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative
1	FILOSA class									
1.1	Euglypha acanthophora Ehrenberg, 1841	Individual/m^3	*	7778	-		*	2778	-	
2	EUROTATORIA class									
2.1	Epiphanes senta (Müller, 1773)	Individual/m^3	*	11667	-		-		*	1556
2.2	Keratella carassa Ahlstrom 1943	Individual/m^3	*	15556	*	5556	*	2222	-	
2.3	Lecane inermis Bryce ,1892	Individual/m^3	*	11667	*	2222	-		-	
2.4	Lecane spp	Individual/m^3	-		-		*	2222	-	
2.5	Trichocerca similis Wierzejski, 1893	Individual/m^3	-		-	5556	-		-	
3	LOBOSA class									
3.1	Difflugia acuminata Dai	Individual/m^3	*	19444	-		-		-	
4	OLIGOTRICHEA class									

No	Characteristic	Unit	AL1		AL2		AL3		AL4	
			Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative
4.1	Leprotintinnus simplex Schmidt, 1902	Individual/m^3	*	23333	-		-		-	
4.2	Leprotintinnus nordqvisti (Brandt) Jorgensen	Individual/m^3	*	19444	-		*	2222	*	1556
4.3	Tintinnidium primitivum Busch, 1923	Individual/m^3	-		-		*	3333	*	2333
4.4	Tintinnopsis estuariensis sp. Nov	Individual/m^3	*	7778	-		-		-	
5	LAVAR									
5.1	Copepoda lavar	Individual/m^3	*	19444	-		*	2778	-	
6	Other classes	Individual/m^3	-		-		-		-	
	Total Species		9		3		6		3	
	Density (population/volume)	Individual/m^3		136111		13334		15555		5445

Note:

*: Qualititative detected

-: Not detected

Appendix B-3 Phythoplankton analyzing results

No.	Characteristic	Unit	AL1		AL2		AL3		AL4	
			Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative	Qualitative	Quantitative
1	CYANOPHYTACL Phylum									
1.1	Phormidium chalybeum	Cell/ Litter	*		*	130	*	49	*	
1.2	Spirulina sp	Cell/ Litter	-		*	65	*	32	*	75
2	BACILLARIOPHYTA Phylum									
2.1	Melosira granulata	Cell/ Litter	*	37	*	32	*		*	75
2.2	Melosira italica	Cell/ Litter	*	93	*	81	*	32	*	673
2.3	Navicula directa	Cell/ Litter	*	19	*		*		*	120
2.4	Nitzschia amphibia	Cell/ Litter	-		*		*	49	*	179
2.5	Surirella brebissonii	Cell/ Litter	-		-		-		*	120
2.6	Surirella robusta	Cell/	-		-		-		*	179

No.	Characteristic	Unit	AL1		AL2		AL3		AL4	
		Litter								
2.7	Surirella sp	Cell/ Litter	*		*	**97**	*	32	*	224
2.8	Synedra ulna	Cell/ Litter	*	**37**	*	**65**	*	49	*	105
3	CHLOROPHYTA Phylum									
3.1	Closterium dianae	Cell/ Litter	-		*	-	*	32	*	194
3.2	Closterium sp	Cell/ Litter	*		*	-	*	32	*	209
3.3	Eudorina cylindrica	Cell/ Litter	*	93	*	-	-		*	120
3.4	Pandorina morum	Cell/ Litter	-		-		-		*	75
3.5	Pediastrum duplex	Cell/ Litter	*		*		-		*	60
3.6	Scenedesmus opoliensis	Cell/ Litter	-		-		-		*	
3.7	Staurastrum arachne	Cell/	-		*		*		*	120

No.	Characteristic	Unit	AL1		AL2		AL3		AL4	
		Litter								
3.8	Staurodesmus convergens	Cell/ Litter	*	93	*		*	16	*	194
3.9	Staurastrum manfeldtii	Cell/ Litter	-		*		*	32	*	224
3.10	Staurastrum muticum	Cell/ Litter	-		*		*		*	150
4	EUGLENOPHYTA Phylum									
4.1	Euglena spirogyra	Cell/ Litter	-		-		-		*	30
4.2	Phacus circum-flexus	Cell/ Litter	-		-		-		*	60
5	Other Phylums	Cell/	-		-		-		-	
	Total Species		10		16		14		22	
	Density (population/volume)	Cell/ Litter		372		567		355		3186

Note:

*: Qualititative detected

-: Not detected

APPENDIX C: IUCN RED LIST OF THREATENED SPECIES WITHIN 50KM OF THE SITE

No.	Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
1	Crocodylus siamensis	Siamese Crocodile	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
2	Heosemys grandis	Giant Asian Pond Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
3	Heosemys annandalii	Yellow-headed Temple Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
4	Indotestudo elongata	Elongated Tortoise	REPTILIA	CR	Decreasing	Terrestrial
5	Manis javanica	Sunda Pangolin	MAMMALIA	CR	Decreasing	Terrestrial
6	Pangasius sanitwongsei	Giant Pangasius	ACTINOPTERYGII	CR	Decreasing	Freshwater
7	Pygathrix nigripes	Black-shanked Douc Langur	MAMMALIA	CR	Decreasing	Terrestrial
8	Catlocarpio siamensis	Giant Carp	ACTINOPTERYGII	CR	Decreasing	Freshwater
9	Heliopais personatus	Masked Finfoot	AVES	CR	Decreasing	Terrestrial, Freshwater
10	Calidris pygmaea	Spoon-billed Sandpiper	AVES	CR	Decreasing	Terrestrial, Marine, Freshwater
11	Gyps bengalensis	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
12	Sarcogyps calvus	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
13	Pseudibis davisoni	White- shouldered Ibis	AVES	CR	Decreasing	Terrestrial, Freshwater
14	Emberiza aureola	Yellow- breasted Bunting	AVES	CR	Decreasing	Terrestrial, Freshwater
15	Cyrtodactylus nigriocularis		REPTILIA	CR	Unknown	Terrestrial
16	Panthera pardus ssp. delacouri	Indochinese Leopard	MAMMALIA	CR	Decreasing	Terrestrial

No.	Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
17	Pelochelys cantorii	Asian Giant Softshell Turtle	REPTILIA	CR	Decreasing	Terrestrial, Marine, Freshwater
18	Cuora amboinensis	Southeast Asian Box Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
19	Macaca fascicularis	Long-tailed Macaque	MAMMALIA	EN	Decreasing	Terrestrial
20	Nycticebus pygmaeus	Pygmy Slow Loris	MAMMALIA	EN	Decreasing	Terrestrial
21	Panthera tigris	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
22	Pteropus vampyrus	Large Flying- fox	MAMMALIA	EN	Decreasing	Terrestrial
23	Dipterocarpus dyeri		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
24	Anisoptera costata		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
25	Dipterocarpus intricatus		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
26	Siebenrockiella crassicollis	Black Marsh Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
27	Trachypithecus germaini	Indochinese Silvered Langur	MAMMALIA	EN	Decreasing	Terrestrial
28	Trachypithecus margarita	Elliot's Silver Langur	MAMMALIA	EN	Decreasing	Terrestrial
29	Viverra megaspila	Large-spotted Civet	MAMMALIA	EN	Decreasing	Terrestrial
30	Gekko badenii		REPTILIA	EN	Decreasing	Terrestrial
31	Pangasianodon hypophthalmus	Striped Catfish	ACTINOPTERYGII	EN	Decreasing	Freshwater
32	Poropuntius deauratus	Yellow Tail Brook Barb	ACTINOPTERYGII	EN	Decreasing	Freshwater
33	Pavo muticus	Green Peafowl	AVES	EN	Decreasing	Terrestrial
34	Asarcornis scutulata	White-winged Duck	AVES	EN	Decreasing	Terrestrial, Freshwater

No.	Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
35	Sterna acuticauda	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
36	Leptoptilos dubius	Greater Adjutant	AVES	EN	Decreasing	Terrestrial, Freshwater
37	Rhacophorus helenae	Helen's Flying Treefrog	AMPHIBIA	EN	Decreasing	Terrestrial, Freshwater
38	Magnolia cattienensis		MAGNOLIOPSIDA	EN	Unknown	Terrestrial
39	Kalophrynus cryptophonus		AMPHIBIA	EN	Decreasing	Terrestrial
40	Calostoma insigne		AGARICOMYCETES	EN	Decreasing	Terrestrial
41	Nomascus gabriellae	Red-cheeked Gibbon	MAMMALIA	EN	Decreasing	Terrestrial
42	Scleropages formosus		ACTINOPTERYGII	EN	Decreasing	Freshwater
43	Macaca fascicularis ssp. fascicularis	Common Long-tailed Macaque	MAMMALIA	EN	Decreasing	Terrestrial
44	Bos gaurus	Gaur	MAMMALIA	VU	Decreasing	Terrestrial
45	Helarctos malayanus	Sun Bear	MAMMALIA	VU	Decreasing	Terrestrial
46	Lutrogale perspicillata	Smooth- coated Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
47	Macaca arctoides	Stump-tailed Macaque	MAMMALIA	VU	Decreasing	Terrestrial
48	Neofelis nebulosa	Clouded Leopard	MAMMALIA	VU	Decreasing	Terrestrial
49	Panthera pardus	Leopard	MAMMALIA	VU	Decreasing	Terrestrial
50	Ursus thibetanus	Asiatic Black Bear	MAMMALIA	VU	Decreasing	Terrestrial
51	Hopea odorata		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
52	Dipterocarpus alatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial

No.	Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
53	Dipterocarpus baudii		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
54	Dipterocarpus costatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
55	Dipterocarpus turbinatus		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
56	Shorea roxburghii	White Meranti	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
57	Shorea guiso	Red Balau	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
58	Shorea thorelii		MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
59	Macaca leonina	Northern Pig- tailed Macaque	MAMMALIA	VU	Decreasing	Terrestrial
60	Arctictis binturong	Binturong	MAMMALIA	VU	Decreasing	Terrestrial
61	Rusa unicolor	Sambar	MAMMALIA	VU	Decreasing	Terrestrial
62	Aonyx cinereus	Asian Small- clawed Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
63	Naja siamensis	Black And White Spitting Cobra	REPTILIA	VU	Decreasing	Terrestrial
64	Ophiophagus hannah	King Cobra	REPTILIA	VU	Decreasing	Terrestrial
65	Labeo pierrei		ACTINOPTERYGII	VU	Decreasing	Freshwater
66	Pangasius krempfi		ACTINOPTERYGII	VU	Decreasing	Marine, Freshwater
67	Elaphe taeniura	Cave Racer	REPTILIA	VU	Decreasing	Terrestrial
68	Python bivittatus	Burmese Python	REPTILIA	VU	Decreasing	Terrestrial
69	Trimeresurus rubeus	Ruby-eyed Green Pitviper	REPTILIA	VU	Decreasing	Terrestrial
70	Zingiber collinsii		LILIOPSIDA	VU	Stable	Terrestrial

No.	Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
71	Mulleripicus pulverulentus	Great Slaty Woodpecker	AVES	VU	Decreasing	Terrestrial
72	Buceros bicornis	Great Hornbill	AVES	VU	Decreasing	Terrestrial
73	Rhyticeros undulatus	Wreathed Hornbill	AVES	VU	Decreasing	Terrestrial
74	Halcyon pileata	Black-capped Kingfisher	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
75	Carpococcyx renauldi	Coral-billed Ground- cuckoo	AVES	VU	Decreasing	Terrestrial
76	Columba punicea	Pale-capped Pigeon	AVES	VU	Decreasing	Terrestrial
77	Sterna aurantia	River Tern	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
78	Clanga clanga	Greater Spotted Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
79	Leptoptilos javanicus	Lesser Adjutant	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
80	Acrocephalus tangorum	White-browed Reed-warbler	AVES	VU	Decreasing	Terrestrial, Freshwater
81	Cyrtodactylus badenensis		REPTILIA	VU	Unknown	Terrestrial
82	Arctonyx collaris	Greater Hog Badger	MAMMALIA	VU	Decreasing	Terrestrial
83	Physignathus cocincinus	Chinese Water Dragon	REPTILIA	VU	Decreasing	Terrestrial, Freshwater
84	Cyrtodactylus thuongae		REPTILIA	VU	Unknown	Terrestrial
85	Dehaasia suborbicularis		MAGNOLIOPSIDA	VU	Unknown	Terrestrial
86	Cinnamomum mabberleyi		MAGNOLIOPSIDA	VU	Unknown	Terrestrial

APPENDIX D: CONSULTATION PARTICIPANTS LIST

This information has been removed as it falls within the exceptions to disclosure specified in para 17 (3.VII) of ADB's Access to Information Policy 2018.